PB87-910202

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 20. NUMBER 2
FEBRUARY 1987

W87-00832 -- W87-01770
CODEN: SWRABW

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 20, NUMBER 2
FEBRUARY 1987

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1987.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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06 WATER RESOURCES PLANNING

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REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,
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INFLUENCE OF MEMBRANE HETEROGENEITY ON THE SOLUTE RETENTION,
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
For primary bibliographic entry see Field 3A.
W87-01101

GEOCHEMISTRY AND AQUEOUS CHEMISTRY OF ALUMINUM,
Geological Survey, Menlo Park, CA.
J. D. Hem.
Kidney International, Vol. 29, No. 18, p S-3-S-7, February 1986. 6 fig, 1 tab, 19 ref.

Descriptors: *Acid rain effects, *Aluminum, *Aqueous chemistry, *Geochemistry, *Water chemistry, Aluminum bonding, Aluminum hydroxide polymerization, Polymerization.

Aluminum is the most abundant metal in the earth's outer crust. It mostly forms alumino-silicates whose crystal structure could be visualized as ordered three-dimensional arrays of O(2-) and OH(-) anions in various packing arrangements. The coordination behavior of Al carries over into its reactions during rock weathering and in precipitation processes that may occur in aqueous solutions. When aluminum is disrupted from primary mineral lattices during weathering, it commonly precipitates in a secondary mineral where Al(3+) is in octahedral coordination with OH(-). In natural waters, aluminum concentrations are small mainly because of its stable structure formation. However, in waters with pH below 4.5 or above 9 or those waters which contain complex ligands, aluminum is quite soluble. The tendency for aluminum ions to attach to negatively charged sites and for relatively stable aluminum hydroxide polymers to grow at such sites could be a mechanism whereby aluminum interfaces with biological processes that occur at and across membrane surfaces. Analytical procedures for determining Al in solution in water may yield unreliable results because of the effects of complexing and hydroxide polymerization. (Khumbatta-PTT)
W87-01502

OCTANOL:WATER PARTITION COEFFICIENTS (P): MEASUREMENT, ESTIMATION, AND INTERPRETATION, PARTICULARLY FOR CHEMICALS WITH P > 100000,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
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W87-01508

2. WATER CYCLE

RADIONUCLIDE TRANSPORT IN FAST CHANNELS IN CRYSTALLINE ROCK,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W87-01626

2A. General

SUMMARY OF THE NINETEENTH MEETING OF THE INTERAGENCY ADVISORY COMMITTEE ON WATER DATA.
Geological Survey, Reston, VA. Water Resources Div.
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GEOCHEMICAL MODELING: A COMPARISON OF FORWARD AND INVERSE METHODS,
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Geological Survey of Canada, Calgary (Alberta).
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W87-00906

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Alaska Univ., Fairbanks. Inst. of Water Resources.
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W87-00907

ANALYTICAL SOLUTION OF LEAF-SHAPED BASIN FLOW,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-01116

EFFECT OF SPATIAL VARIABILITY OF EFFECTIVE RAINFALL ON DIRECT RUNOFF BY A GEOMORPHOLOGIC APPROACH,
Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.
C. Corradini, and V. P. Singh.
Journal of Hydrology, JHYDA7, Vol. 81, No. 1/2, p 27-43, October 30, 1985. 5 fig, 10 tab, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall, *Runoff, *Geomorphology, *Model studies, Rainfall distribution, Precipitation, Rainstorms, Storms, Italy.

The importance of spatial variability of effective rainfall input to a direct runoff model was analyzed by the geomorphologic approach based on the use of different paths determined according to the Horton-Strahler ordering scheme. Actual effective rainfall distributions were derived from observed rainfall-runoff events on four large basins in Central Italy, together with synthetic storms, preserving effective rainfall depths. Storms of different time distribution were used, and for each of them sensitivity of basin response to the spatial variability of effective rainfall was computed. Sensitivity was minor. A comparison of the geomorphologic approach with the Clark method was also carried out for the spatially variable synthetic storms of 1 h duration. The Clark method was more sensitive to spatial variability of effective rainfall. It is argued that it is unreasonable to use the geomorphologic approach in computing basin response for spatially variable effective rainfall as model input. An analysis of the distribution throughout the basin of overland regions composing each path revealed that the averaging scheme of the channel network, following the Horton-Strahler ordering scheme, was inappropriate. (Author's abstract)
W87-01171

SENSITIVITY ANALYSIS, CALIBRATION AND PREDICTIVE UNCERTAINTY OF THE INSTITUE OF HYDROLOGY DISTRIBUTED MODEL,
Bristol Univ. (England). Dept. of Geography.
C. C. M. Rogers, K. J. Beven, E. M. Morris, and M. G. Anderson.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2 p 179-191, October 30, 1985. 7 fig, 2 tab, 16 ref. National Environment Research Council (England) Grant GR3/4840.

Descriptors: *Rainfall-runoff relationships, *Model studies, *IHDM, *Hydrology, *Catchment/areas,, *Sensitivity analysis, Storms, Calibrations, Flow profiles.

The physically based Institue of Hydrology Distributed Model (IHDM) is briefly described and applied to the Tanllwyth catchment, Powys, Wales. Model predictions were found to be most sensitive to a surface flow roughness parameter and the saturated hydraulic conductivity of the soil. Effective values were determined by minimizing an error function for the simulation of five storms. The ability of the IHDM to forecast flood flows, using known parameter values and without using measured flows to optimize the values, was demonstrated by using the effective parameter values for two other storms. The variation in calibrated parameter values between storms events was taken as an estimate of the uncertainty associated with the 'effective' parameter values. This variation is small compared with the expected variation for different vegetation and soil types. However, the Rosenblueth method indicates that there is significant uncertainty in flow predictions for the two additional storms associated with the use of uncertain effective parameters. (Doria-PTT)
W87-01177

ESTIMATION OF PARAMETERS OF THE DISCRETE, LINEAR, INPUT-OUTPUT MODEL.
Academia Sinica, Beijing (China). Inst. of Geography.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 15-30, June 15, 1986. 1 fig, 2 tab, 15 ref.

Descriptors: *Model studies, *Estimating, *Hydrologic models, *Rainfall-runoff relationships, Mathematical studies, Estimating equations, Least-squares method.

Significant advances have been made in adapting the linear systems theory for modeling the rainfall-runoff process. Such hydrologic models, known as input-output models, attempt to establish a causal linkage between two or more observed phenomena without detailed description of the physical process under investigation. Some properties of discrete, linear, hydrologic, input-output models are described, and four different methods are suggested for estimating model parameters. These include least-squares, correlation functions, linear programming, and quadratic programming. Numerical examples show the use of these methods. (Doria-PTT)
W87-01178

USE OF THE CHLORIDE ION IN DETERMINING HYDROLOGIC-BASIN WATER BUDGETS - A 3-YEAR CASE STUDY IN THE SAN JUAN MOUNTAINS, COLORADO, U.S.A.,
Geological Survey, Denver, CO.
H. C. Claassen, M. M. Reddy, and D. R. Halm.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 49-71, June 15, 1986. 5 fig, 7 tab, 15 ref. USGS-DOE Interagency Agreement DE-AI08-76DP00474.

Descriptors: *Groundwater movement, *Tracers, *Watersheds, *Hydrologic budget, *San Juan Mountains, Colorado, *Case studies, *Soil water,

*Recharge, Available water, Chlorides, Precipitation, Evaporation, Runoff.

Measurement of chloride concentration and water equivelent in precipitation and recharge at a site can be extrapolated to determine available moisture in a nearby basin. This method also may be extrapolated to a basin with similar climatic characteristic if precipitation, vegetation, and topographic data are available. Soil-moisture measurements indicate the average 10% error in moisture balace can be attributed to annual changes in storage. Data requirements for the method are considerably less than data requirements for energy-budget methods. Potential applications include: (1) estimating total available moisture from chloride concentrations in groundwater or surface water or both; (2) modeling paleoclimatic scenarios and evaluating their correctness by comparison with paleo-groundwater chloride concentrations; and (3) providing an independent comparison for water budgets obtained by energy-budget methods. The method cannot be applied readily to systems with a lithologic source of chloride. Most systems consisting primarily aof tuff, intrusive volcanic rock, nonmarine sediments, quartzite, and other metamorphic rocks are suitable for application of the model. (Author's abstract)
W87-01180

ENTROPY AS A MEASURE OF HYDROLOGIC DATA UNCERTAINTY AND MODEL PERFORMANCE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-01183

RELATIONSHIP BETWEEN DATA AND THE PRECISION OF PARAMETER ESTIMATES OF HYDROLOGIC MODELS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
V. K. Gupta, and S. Sorooshian.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 57-77, October 30, 1985. 8 fig, 2 tab, 21 ref. NSF Grant CEE-8217823.

Descriptors: *Hydrologic models, *Parameter estimates, Maximum likelihood approach, Simultaneous studies, Rainfall-runoff models, Parametric hydrology, Mathemastical studies, Statistics.

The relationship between data used for hydrologic model calibration and the precision of model parameter estimates is discussed. The analysis was conducted within the framework of the maximum likelihood approach to model selection. The concept of 'information' is discussed and the relationship between information and parameter uncertainty is examined. That analysis provides some interesting insights into the role the quality and quantity of the data used play in the identification procedure. A method is suggested for selecting data sets suitable for model calibration. The ideas are illustrated by means of simulation studies using a conceptual-type rainfall-runoff model. Some insight is provided of the relationships between characteristics of the data and parameter precision. These ideas have relevance to selecting and devising model parameters having orthogonal effects on the objective function, and the trade-offs between data availability and the degree of model sophistication. (Khumbatta-PTT)
W87-01193

DETERMINATION OF PARAMETERS BY LINEAR PROGRAMMING, FOR A MODEL WITH N-LINEAR RESERVOIRS IN SERIES,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2E.
W87-01196

PARTIAL AREA HYDROLOGY AND REMOTE SENSING,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 7B.
W87-01198

IMPROVEMENTS IN THE INVERSE ESTIMATION METHOD OF EFFECTIVE RAINFALL FROM RUNOFF,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
M. Hino.
Journal of Hydrology JHYDA7, Vol. 83, No. 1/2, p 137-147, January 15, 1986. 5 fig, 12 ref.

Descriptors: *Rainfall-runoff relationships, *Linear models, *Stochastic models, *Effective rainfall, *Runoff, *Inverse estimation method, Nonlinear hydrologic system, Effective precipitation, Rainfall-runoff volume.

A method is presented for improving inverse estimation of effective rainfall subsystems from runoff time series. False stochastic fluctuations can be eliminated by statistical means. Hydrologic systems are generally nonlinear although they may be considered to be composed of linear subsystems. The nonlinearity is caused mainly by the nonlinear separation of rainfall into the subsystems. Therefore the effective rainfall components for each linear subsystem may be estimated from the runoff component time series by the linear expression of the unit hydrograph. The methods of obtaining the realizable unit hydrograph ordinates are applied to derive the rainfall component time series for a subsystem. The two alternate methods, i.e. the smoothed least squares and the LP (Linear Programming) technique may be applied to eliminate the stochastic error inherent in time series from the hydrological system, if its level is not high. Comparison between the results obtained by these methods guarantees their reliability and affords the bases for the further application. (Khumbatta-PTT)
W87-01201

RELATIONSHIP BETWEEN THE RUNOFF CURVE NUMBER AND HYDROLOGIC SOIL PROPERTIES,
Southern Illinois Univ. at Carbondale. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 2G.
W87-01261

SEPARATION OF A SNOWMELT HYDROGRAPH BY STREAM CONDUCTANCE,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2C.
W87-01269

CONSIDERATION OF THE INTRASEASONAL VARIATION OF THE PROBABILITY OF MAXIMUM DISCHARGES,
V. E. Belikov, G. I. Eremeeva, and B. Y. Kagan.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 16-21, July 1985. 2 fig, 3 tab, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 1, January 1985.

Descriptors: *Maximum flow, *Floods, *Runoff, *Model studies, *Flood flow, Flow, Rainfall, Rivers.

An objective and interrelated calculation that considers the intraseasonal variations of equiprobable maximum discharges can be performed using the multiflood method based on the more complete than usual use of available runoff information. The multiflood method is based on use of curves of the every-flood probability exceedance (EFPE). When plotting these curves, all independent, practically significant floods are considered (floods whose maximum discharges are close to the minimum discharge from the series of the annual maximum flood discharges during long-term observation). The calculations and plottings are described. Consideration of the time factor when calculating annual variations of equiprobable discharges performed on the basis of the multiflood method can result in substantial economy in the construction and operation of hydrostations without exceeding the standard permissible degree of risk of destruction of the structure by water overflowing the channel or reservoir. The expenses for additional design development will be a negligible fraction of the savings realized. (Doria-PTT)
W87-01353

IMPORTANCE OF THE CONVERGENCE CRITERION IN THE AUTOMATIC CALIBRATION OF HYDROLOGICAL MODELS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Isabel, and J. -P. Villeneuve.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1367-1370, September 1986. 1 fig, 5 tab, 14 ref.

Descriptors: *Convergence criteria, *Calibration, *Hydrologic models, *Rainfall-runoff relationships, Model studies, Performance evaluation, Mathematical studies, Mathematical analysis.

The automatic calibration of conceptual rainfall-runoff models is an increasingly popular technique, and several scientists have studied the respective merits of various algorithms of nonlinear optimization and of different objective function. In order to do so they often have used the synthetic calibration. This is a calibration whose measured output is replaced by a series previously calculated by the model, using arbitrary known values as parameters. The precision of a synthetic calibration can be evaluated by comparing the estimated parameters to the values used to generate the synthetic series. However, several studies of the synthetic calibration of conceptual rainfall-runoff models reveal imprecise experimental results. In order to identify the reason(s) behind this lack of accuracy, a similar experiment was conducted, and it was observed that the precision of obtained results depended upon the strictness of the convergence criterion. It is therefore recommended that circumspection be used in the interpretation of the results of synthetic calibration whose convergence criteria are not very severe. It is also suggested that a criterion be used that is as strict as the numerical precision of the computer will allow. However, one now has to evaluate if the strictness of the convergence criterion is as important in the case of real calibration. (Lantz-PTT)
W87-01585

PERIODIC GAMMA AUTOREGRESSIVE PROCESSES FOR OPERATIONAL HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-01588

DISCRETE CONCEPTUALIZATION OF A VOLTERRA SERIES MODEL FOR SURFACE RUNOFF,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
J. J. Napiorkowski, and Z. W. Kundzewicz.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1413-1421, September 1986. 1 fig, 16 ref, append.

Descriptors: *Mathematical models, *Volterra Series Model, *Surface runoff, *Hydrologic models, *Cache River, *Rainfall-runoff relationships, Illinois, Model studies, Discrete conceptualization, Reservoirs.

The Volterra series rainfall-runoff model used to be regarded as a nonlinear black box, with no correspondence between the physical prototype and the model parameters. However, as was outlined in earlier studies, the output signal of a cascade of identical nonlinear reservoirs can be approximately expressed in the form of a Volterra series model. This offers obvious advantages in the process of identification due to the parsimony of parameters. The conceptualization of the Volterra series model performed in the present study is based on a state space formulation within the discrete framework justified in view of the inherently discrete problems that arise in practice. The meth-

odology is tested on data from the catchment of the Cache River in southern Illinois. The results obtained prove that the model of cascade of identical nonlinear dynamic systems (e.g., uniformly nonlinear reservoirs) lends itself to applications to both flood routing and to rainfall-runoff modeling. One can also conclude that the methodology presented should enable other methods of conceptualization to be used. That is, other physically significant nonlinear models (e.g., in the case of open channel flow, models of hydrodynamic origin) can be linked with the Volterra series kernels. (Lantz-PTT)
W87-01591

WATER AND AIR INTAKE OF SURFACE-EXPOSED ROCK FRACTURES IN SITU,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. K. Kilbury, T. C. Rasmussen, D. D. Evans, and A. W. Warrick.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1431-1443, September 1986. 12 fig, 3 tab, 13 ref, 2 append. NRC Contract No. NRC-04-81-224.

Descriptors: *Water intake, *Air intake, *Surface water, *Geologic fractures, *Infiltration, *Path of pollutants, Site selection, Hazardous wastes, Model studies, Mathematical studies, Mathematical analysis.

The siting and reclamation of hazardous waste disposal facilities may require the examination of solute transport through networks of fractures within lithic units. Water intake at the surface of a fractured rock medium may provide a transport mechanism for the movement of hazardous wastes. A dual-chambered fractured rock infiltrometer (FRI) is used to provide in situ measurements of water and air intake rates for isolated fracture segments. The FRI is used to apply a known head to an exposed fracture segment and to provide a precise means for measuring the intake rate. Water intake rates for fractures in an exposed, densely welded tuff are highest at early time, then fall to a constant rate. Analytical procedures are developed to estimate fracture apertures using the Green and Ampt model and Poiseuille's law. Calculated fracture apertures from water intake data range from 1.0 to 33.7 micrometers, and are approximately lognormally distributed. An analytical expression relating air intake data to fracture aperture is derived using the Schwartz-Christoffel transformation. Estimated apertures using this experimental technique range from 10.0 to 37.2 micrometers, and appear to fit the same lognormal distribution. (Author's abstract)
W87-01593

STEADY INFILTRATION FROM LARGE SHALLOW PONDS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
G. J. Weir.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1462-1468, September 1986. 2 fig, 1 tab, 11 ref, append.

Descriptors: *Infiltration, *Ponds, *Mathematical studies, *Porous media, Boundary conditions, Saturated flow, Capillarity, *Surface-groundwater relations, Flow pattern, Vertical flow.

Exact quasi-linear solutions are obtained for steady infiltration from a shallow half plane pond on the surface of an isotropic semi-infinite porous medium. Three particular boundary value problems are considered: the constant Dirichlet boundary conditions in relative permeability and vertical flux, and a mixed boundary value problem. The boundary conditions on the surface of the porous media for these problems correspond physically, first, to fully saturated conditions under the pond and fully unsaturated conditions elsewhere; second, to a constant vertical flux under the pond and zero vertical flux elsewhere; and third, to fully saturated conditions under the pond and zero vertical flux elsewhere. Each problem has essentially the same diffusive boundary layer, or capillary fringe, connecting the fully saturated and unsaturated regions. The total flux per unit length of boundary due to capillarity in the first problem is infinite, and for the latter two problems, finite constants. Strong analogies between the results for a surface source and the corresponding results for buried spherical and cylindrical sources are established. Finally, the exact results for the half plane pond are used in an approximate description of steady infiltration from a large shallow pond of arbitrary shape, subject to the minimum radius of curvature of the pond's perimeter, which is large relative to 2/alpha, where alpha is the inverse length scale introduced in quasi-linear models. A boundary layer develops from capillarity at the pond's edge, away from which the solution is adequately described by a diffusion equation representing a balance between the vertical flow from gravity and the horizontal flow from capillarity. An approximate expression is obtained analytically for the total flow from large shallow ponds. (Author's abstract)
W87-01596

STORM RUNOFF GENERATION IN HUMID HEADWATER CATCHMENTS: 1. WHERE DOES THE WATER COME FROM,
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 2E.
W87-01628

STORM RUNOFF GENERATION IN HUMID HEADWATER CATCHMENTS: 2. A CASE STUDY OF HILLSLOPE AND LOW-ORDER STREAM RESPONSE,
Windsor Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2E.
W87-01629

STATISTICAL METHODOLOGY FOR ESTIMATING TRANSPORT PARAMETERS: THEORY AND APPLICATIONS TO ONE-DIMENSIONAL ADVECTIVE-DISPERSIVE SYSTEMS,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-01632

2B. Precipitation

PRECIPITATION GAGE DATA COLLECTION AND ANALYSIS IN SUPPORT OF SCPP: INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
R. A. Rilling, K. L. Dreher, G. R. Price, and S. F. Barnes.
For Period August 26, 1985 to August 31, 1985. October 1985. 154 p, 47 fig, 12 tab, 4 append. Contract No. 4-CR-81-03320.

Descriptors: *Rain gages, *Data collections, *Artificial precipitation, *Weather modification, *Data interpretation, Sierra Cooperative Pilot Project, Networks, Precipitation, Gages, Orographic precipitation.

Work performed between August 26, 1984 and August 31, 1985, in support of the Sierra Cooperative Pilot Project (SCPP), is summarized. Tasks included the operation of a precipitation gage network during the winter season in the Sierra and analysis of data from that network. In addition, developmental work was carried out on a new precipitation gage system. Included in this report is an outline of field procedure and data processing routines used to ensure a quality data set. Analyses of these data are also provided. A special section details work on the developmental gage system, highlighting performance characteristics that lead to the recommendation that the mechanical Belfort gages be replaced by one type of developmental gage. (Lantz-PTT)
W87-00887

ACID DEPOSITION: LONG-TERM TRENDS.
National Research Council, Washington, DC. Committee on Monitoring and Assessment of Trends in Acid Deposition.
For primary bibliographic entry see Field 5C.
W87-00971

SUMMARY AND SYNTHESIS.
For primary bibliographic entry see Field 5C.
W87-00972

UNCERTAINTIES IN TRENDS IN ACID DEPOSITION: THE ROLE OF CLIMATIC FLUCTUATIONS,
Massachusetts Univ., Amherst.
R. S. Bradley.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 93-108, 10 fig, 20 ref.

Descriptors: *Acid rain, *Climatic fluctuations, *Forecasting, *Research priorities, Ecological effects, Temporal distribution, Spatial distribution, Ecosystems, Path of pollutants, Air pollution.

Acid deposition is the end product of a series of complex processes involving emission of precursors, chemical transformations in the atmosphere, physical transport of the pollutants through the atmosphere, and eventual dry or wet deposition. Considerable attention has focused on the influence of meteorological processes on acid deposition, with particular emphasis on source-receptor relationships to determine the origin and the route of transport of deposited materials. In assessing changes in acid deposition over time scales longer than seasons, however, short-term meterological variability is less significant than longer-term climatic variability. Climate is a statistical expression of daily weather events; but, over time periods of years and decades, changes in climate do occur, and these may be of considerable importance when evaluating long-term records of acid deposition. Clearly, temporal and spatial variations in atmospheric circulation over extended periods may directly influence patterns of deposition. Climatic fluctuations may also bring about changes in ecological conditions that could either accentuate or mask the effects of acid deposition. In trying to understand the effect that acid deposition may have had on various ecosystems it is important to have a clear understanding of the effects of climatic variations on the ecosystems. Because this type of analysis has rarely been carried out, research should focus on the following topics: (1) The effects that climatic variability may have on those systems thought to be affected by acid deposition, such as aquatic and forest ecosystem, and (2) The implications of long-term climatic changes for trends in acid deposition both in the past and in the future. (See also W87-00971) (Lantz-PTT)
W87-00973

PRECIPITATION CHEMISTRY,
Illinois State Water Survey Div., Champaign.
G. J. Stensland, D. M. Whelpdale, and G. Oehlert.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 128-199, 25 fig, 13 tab, 39 ref.

Descriptors: *Chemistry of precipitation, *Wet deposition, *Environmental effects, Meteorology, Hydrogen, Bicarbonate, Calcium, Magnesium, Sodium, Potassium, Sulfates, Nitrates, Chloride, Ammonium, Air pollution.

The chemical composition of wet deposition has been central to the question of the effects of acid deposition and the long-range transport of air poilution since the issue of acid rain rose to prominence in Europe two decades ago. The chemistry of precipitation has been studied both in the expectation that it will provide a measure of the consequences of emissions in time and space and also as an indicator of effects on the environment. Unfortunately, problems exist both with the quality of past data and with the interpretation of the data. These difficulties have stimulated the examination of other historical data in efforts to improve our understanding of the phenomenon of acid deposi-

tion and to corroborate the available precipitation chemistry records. This chapter studies wet precipitation, specifically the major soluble species in precipitation (H(+), HCO3(-), Ca(2+), Mg(2+), Na(+), K(+), SO4(2-), NO3(-), Cl(-), and NH4(+)), and the role meteorology plays in the variability of acid deposition. (See also W87-00971) (Lantz-PTT)
W87-00974

STREAMS AND LAKES,
McMaster Univ., Hamilton (Ontario).
For primary bibliographic entry see Field 5B.
W87-00975

FISH POPULATION TRENDS IN RESPONSE TO SURFACE WATER ACIDIFICATION,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5C.
W87-00976

PROJECT SKYWATER: 1984-85 SCPP DATA INVENTORY.
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 3B.
W87-00980

NITRITE IN RAINWATER,
Essex Univ., Colchester (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-01070

URBAN DEW: ITS COMPOSITION AND INFLUENCE ON DRY DEPOSITION RATES,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
P. A. Mulawa, S. H. Cadle, F. Lipari, C. C. Ang, and R. T. Vandervennet.
Atmospheric Environment ATENBP, Vol. 20, No. 7, p 1389-1396, July 1986. 2 fig, 5 tab, 34 ref.

Descriptors: *Dew, *Acid rain, *Acid dew, *Urban areas, *Rain chemistry, *Dry deposition, Michigan, Calcium, Chlorides, Nitrates, Sulfates, Sodium, Potassium, Ammonium, Nitric acid, Hydrochloric acid, Ammonia, Sulfur dioxide, Teflon dew sampler, Deposition.

The composition of dew collected from a Teflon surface was compared to summer rainwater concentrations at a site in Warren, MI. This comparison showed that natural dew is similar to rainwater with the exception that dew has much higher concentrations of Ca(2+) and Cl(-) and much lower acidity. Dry deposition rates for several species were measured to artificially-generated dew and dry surface. Deposition rates were 2-20 times greater to the artificial dew than to the dry surface, indicating that the presence of dew enhances both the retention of dry deposited particles and the absorption of water soluble gases. Measurement of the atmospheric concentrations of the depositing gases permitted the calculation of deposition velocities for particulate Cl(-), NO3(-), SO42(-), Ca(2+), Mg(2+), Na(+), K(+), and NH4(+). Deposition velocities for gaseous HNO3, HCl, SO2, and NH3 were also determined after correction for particle deposition. These results indicate that acid dew is not a problem at this site. Dew may be more acidic at sites where deposition rates of basic particles are lower. (Author's abstract)
W87-01071

REGIONAL-SCALE PRECIPITATION SCAVENGING OF SO2, SO4, NO3, AND HNO3,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
For primary bibliographic entry see Field 5B.
W87-01072

REVIEW OF THE SIERRA COOPERATIVE PILOT PROJECT,
Bureau of Reclamation, Auburn, CA. Auburn-Folsom South Unit.
For primary bibliographic entry see Field 3B.
W87-01095

HYBRID MARKOVIAN MODEL FOR THE SIMULATION OF DAILY RAINFALL DATA (MODEL MARKOVIEN DE TYPE HYBRIDE POUR LA SIMULATION DE LA PLUVIOMETRIE JOURNALIERE),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
C. Thirriot, and M. Arnaud.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 302, No. 18, p 1161-1164, May 24, 1986. 3 fig, 1 tab, 7 ref.

Descriptors: *Markov process, *Rainfall, *Simulation, *Conditional correlation, Mathematical models, Variation coefficient, Toulouse, France.

After presenting results of rainfall simulation with a first-order binary Markov model, the authors show that it is possible to improve results by increasing the order of the conditional correlation. This is true for discrete modeling of the dry and wet state of a day as well as the attribution of rainfall height to a wet day. The simulation model was calibrated by comparing the variation coefficient of measured and generated series for Toulouse (France). The same was done also for a monthly model. (Author's abstract)
W87-01097

AUTORUN MODEL FOR SYNTHETIC FLOW GENERATION,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
For primary bibliographic entry see Field 2E.
W87-01195

HEAVY METAL CONTENT OF RAINWATER IN GENEVA, NEW YORK, DURING 1983,
Hobart and William Smith Colleges, Geneva, NY. Dept. of Chemistry.
C. F. Aten, J. B. Bourke, and J. C. Walton.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 918-923, June 1986. 4 tab, 6 ref.

Descriptors: *Heavy metals, *Chemistry of precipitation, *Rain, *Geneva, New York, Chemical properties, Calcium, Magnesium, Iron, Zinc, Cadmium, Detection limits.

A survey of heavy metals in rainfall at Geneva, New York was reported earlier. It was found that calcium and magnesium were the most prevalent elements and were strongly correlated, while the concentrations and absolute amounts of zinc, iron, and phosphorus were small and not well correlated. The total amount of cadmium was quite large but poorly correlated with anything else. This study is a partial repetition of the earlier one over the interval March through October 1983. Concentrations of zinc and manganese were found to be 0.017 and 0.008 mg/l, respectively, comparable to values reported previously. However, mean cadmium concentration was 50 to 100 times greater than the other values. The source of cadmium is unknown, but appears not to be local. (Doria-PTT)
W87-01222

DETERMINATION OF THE COMPONENTS OF STORMFLOW USING WATER CHEMISTRY AND ENVIRONMENTAL ISOTOPES, MATTOLE RIVER BASIN, CALIFORNIA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2K.
W87-01267

ANALYSIS AND MODELLING OF RUNOFF IN THE SAHEL REGION (OURSI POND, BURKINA FASO) (ANALYSE ET MODELISATION DU RUISSELLEMENT EN REGION SAHELIENNE (MARE D'OURSI, BURKINA FASO),
Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast). Centre d'Adiopodoume.
P. Chevallier.
La Houille Blanche, No. 6/7, p 573-580, 1985. 4 fig, 18 ref.

Descriptors: *Model studies, *Surface runoff, *Sahel region, *Drought, Oursi Pond, Groundwater, Surface Water, Maps, Satellite technology, Africa, Remote sensing.

Methods used to analyze and model runoff in the Mare Oursi drainage area in the Sahel region (Burkina Faso) require a good knowledge of the terrain and also high quality raw data. Satellite images were used to develop hydrologic maps of the region. Between 15 and 20 crests occur each year in each water basin vlowing into the Mare Oursi. These crests are caused by runoff following intense downpours. The following data were determined for each crest: (1) date of downpour; (2) average rain amount; (3) maximum intensity (mm/hr); (4) height of the downpour with an intensity of >20 mm/hr; (5) runoff swell; (6) index of previous precipitation. The data were analyzed using multiple regression techniques and a runoff model developed based on spatial discretization. If the Sahel region is to develop, its water resources must be understood and controlled; since runoff is the essential contributor to the water resources of the area, the control of runoff is essential. (Peters-PTT)
W87-01333

MERCURY LEVELS IN RAIN AND AIR AND THE SUBSEQUENT WASHOUT MECHANISM IN A CENTRAL ITALIAN REIGON,
For primary bibliographic entry see Field 5B.
W87-01423

ARGONNE'S ACID RAIN STRATEGY VS. S. 3041,
For primary bibliographic entry see Field 5B.
W87-01439

RADAR-BASED STOCHASTIC MODEL FOR SHORT-TIME-INCREMENT RAINFALL,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas, and K. R. Herd.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1437-1455, September 1985. 19 fig, 2 tab, 26 ref. NSF Grant CEE-8411896.

Descriptors: *Remote sensing, *Radar, *Model studies, *Rainfall intensity, *Depth-area-duration analysis, *Rainfall distribution, Rainfall, Statistical methods, Poisson ratio, Model testing, Mathematical studies.

A single-site stochastic model is developed to describe the evolution of rainfall depths at all time scales smaller than or equal to one day, using information on the rain fields that are detected on the weather radar plan position indicator scope. This conceptualization states that rainfall in time at any ground location can be described by the rainfall intensity distribution over the trajectories which are drawn by the ground location point on the rain fields that pass over this location. The model has the structure of a filtered Poisson cluster process. The model is calibrated by a nonparametric procedure using 5-min-increment radar microfilm and hourly rain gage data during April. The calibrated model is used first in estimating the rain-gage-observed hourly and daily mean rainfall depths during a period which envelops the calibration period plus an extra year's test period during April. It is then used in the real-time radar-based estimation of hourly rainfall depths during the test period. Results show that the radar-based conceptualization is a useful approach to the modeling of rainfall depths at time increments smaller than or equal to one day. (Doria-PTT)
W87-01537

RELATIONSHIP BETWEEN A CONTINUOUS-TIME RENEWAL MODEL AND A DISCRETE MARKOV CHAIN MODEL OF PRECIPITATION OCCURRENCE,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of

Civil Engineering.
M. J. Small, and D. J. Morgan.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1422-1430, September 1986. 10 fig, 1 tab, 37 ref.

Descriptors: *Markov process, *Time series analysis, *Precipitation, *Model studies, Mathematical models, Rainfall, Mathematical equations, Rainfall intensity, Mathematical studies.

A relationship between a continuous wet-dry model with gamma distributed intervals and a Markov chain model for daily rainfall is derived. The relationship requires numerical evaluation for the general case, but closed-form solutions are available for the Markov process case in which dry intervals are exponentially distributed. The Markov process equations are equivalent to those previously derived for first-order transition probabilities, but are presented in a simplified, nonrecursive form. The Markov process relationships are examined for convergence and accuracy with simulation studies and comparison to observed rainfall records. The Markov process model provides a good representation in certain parts of the United States. In other areas where the Markov property is inappropriate due to event clustering or other phenomena, the gamma model provides an improved characterization of the relationship between continuous and discrete rainfall occurrence. The relationships derived are important in that they link two of the most basic and widely used probabilistic models of precipitation occurrence. Both the discrete daily model and the continuous process model are utilized frequently in meteorological and hydrological applications. The gamma renewal model provides a continuous process representation complementary to the point process cluster models developed in recent years. The ability to relate the gamma model to the daily Markov chain model provides a useful theoretical and practical tool for the characterization of precipitation occurrence. (Lantz-PTT)
W87-01592

COMPARISON OF CHEMICAL AND ISOTOPIC HYDROGRAPH SEPARATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
R. P. Hooper, and C. A. Shoemaker.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1444-1454, September 1986. 10 fig, 1 tab, 19 ref.

Descriptors: *Simulation analysis, *Hydrographs, *Model studies, *Chemical analysis, *Isotope studies, *Acid rain, Environmental tracers, Snowmelt, Storm runoff, New Hampshire, Path of pollutants.

As part of the construction of a simulation model to test an acid precipitation neutralization mechanism, the stream hydrograph was separated into its base flow and event water components using stable environmental isotopes of water, naturally occurring conservative tracer. Three snowmelt events and one storm event during the winter and spring of 1984, were studied at an instrumented watershed in the Hubbard Brook Experimental Forest, New Hampshire. Conditions for use of the isotopic tracer were not always met, however. During the latter part of the snowmelt and the storm, the isotopic content of the groundwater and event water were not distinguishable. Furthermore, the isotopic content of the meltwater varied considerably over time, thereby reducing the precision of the hydrograph separation. Frequent sampling of the meltwater is mandatory to assess this variability. Because the concentration of major cations and anions was measured as well, chemical tracers could be compared to the isotopic tracer, when the isotopic hydrograph separation was reliable, to test whether the chemical tracer was conservative. Dissolved silica acted as a conservative tracer for this watershed. (Author's abstract)
W87-01594

GAMMARIDS IN STREAMS OF NORTHEASTERN BAVARIA, F.R.G.: I. PREDICTION OF THEIR GENERAL OCCURRENCE BY SELECTED HYDROCHEMICAL VARIABLES,
Fachhochschule Weihenstephan, Freising (Germany, F.R.). Fachbereich Landespflege.
For primary bibliographic entry see Field 2H.
W87-01616

COMPATIBILITY OF CONTINUOUS RAINFALL OCCURRENCE MODELS WITH DISCRETE RAINFALL OBSERVATIONS,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. Foufoula-Georgiou, and P. Guttorp.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1316-1322, August 1986. 3 tab, 9 ref, append. NSF Grant MCS-8302573.

Descriptors: *Rainfall, *Discrete analysis, *Model studies, Rainfall intensity, Rainfall distribution, Mathematical analysis, *Statistical analysis, Correlation analysis.

Inferences about the underlying rainfall generating mechanism made through a model fitted to the sampled rainfall series at a particular time scale, are meaningful only if they are invariant under the time scale of measurement at which the fitting of the model is made. Following previous studies, this assertion is tested by examining the compatibility of the Neyman-Scott (N-S) model for the continuous underlying rainfall with sampled realizations taken over intervals ranging from one hour to one day. Several observations regarding the N-S white noise model have been made. FIrst, the autocorrelation function of the rainfall amounts series resulting from integration of the N-S white noise model has a Markovian dependence structure depending only on the parameters of the clusters, and not the parameter of the instantaneous rainfall amounts. This observation leads to a simple fitting procedure. Second, the assumed distribution (Poisson or geometric) for the cluster size plays an important role in the final N-S model. Therefore since selection of the one distribution versus the other does not seem possible based solely on physical considerations, it does not seem possible to attach a physical meaning to the model parameters, and the N-S process must be interpreted as a descriptive and time scale-dependent model, rather than a prescriptive one. These findings are quite general, in that they apply to any model with rainfall deposited instantaneously at times described by a N-S process, regardless of how the amounts associated with the events are distributed, and of the dependence structure of the amounts. (Lantz-PTT)
W87-01633

REMOTE ANALYSIS OF GROUND WATER CONTAMINANTS USING LASER FLUORESCENCE,
Tufts Univ., Medford, MA. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5A.
W87-01696

SATELLITE SUPPORT TO THE SIERRA COOPERATIVE PILOT PROJECT: 1979 TO 1984,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
T. H. Vonder Haar, J. L. Behunek, and D. W. Hillger.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86-114881, A06 in paper copy, A01 in microfiche. Final Report, October 1984. 99 p, 24 fig, 16 tab, 12 ref. Contract No. 9-07-85-V0025.

Descriptors: *Satellite technology, *Remote sensing, *Sierra Cooperative Pilot Project, *Cloud seeding, Sierra Nevada Mountains, Cascade Mountains, Remote sensing, Infrared imagery, Clouds, Temperature, Statistical studies, Orographic precipitation, Weather modification.

Digital satellite data were collected and analyzed at Colorado State University in support of the Sierra Cooperative Pilot Project (SCPP) between 1979 and 1984. Those data encompassed a large geographical area, including the Sierra Nevada and most of the Cascade Range, the eastern North Pacific Ocean, and portions of the Great Basin downwind of the Sierra Nevada. The satellite data were collected from the visible and infrared spectral channels. All of the satellite data were navigated to allow the accurate location of geographic points within the images. Permanent archives of the satellite data are available to all researchers on magnetic tape from the Bureau of Reclamation. Statistical analyses of SCPP cloud field properties were an important part of the research work performed under the contract. The first of those analyses computed the average cloud top temperature for each Precipitation Echo Type and a measure of the deviation from that average from the 1979/80 satellite data. Similar statistical studies were continued for the 1982/83 and 1983/84 data sets, with emphasis on stable orographic precipitation (SCPP-2) conditions. A study of the statistical correlation between satellite-derived cloud top temperature and precipitation at the surface showed that cloud top temperatures could be useful as a precipitation covariate during SCPP-2 events. Periods of cirrus cloud presence also were documented, showing that cirrus clouds often were present during the SCPP experiment. Finally, a study of the areal coverage and cloud top temperatures of small cumulus cells (SCPP-1 candidate clouds) yielded information relevant to the natural orographic effect on those clouds and the areas where they typically form and are suitable for study. Case studies of the SCPP digital satellite data examined smaller portions of that data set. One case study looked at satellite-observed characteristics of clouds already classified (by radar) according to their Precipitation Echo Type. That study showed that PET classification may be accomplished by satellite in many cases. The other case study utilized the videotaped satellite image loops to investigate the interaction between convection and atmospheric gravity waves in the SCPP region. (Author's abstract)
W87-01761

SCPP METEOROLOGICAL AND STATISTICAL SUPPORT FOR PERIOD 1 SEPTEMBER 1984 - 31 AUGUST 1985, VOLUME II: (EXPERIMENTAL DAY SUMMARIES) INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 7B.
W87-01763

2C. Snow, Ice, and Frost

DEVELOPING A WATER WELL FOR THE ICE BACKFILLING OF DYE-2,
Cold Regions Research and Engineering Lab., Hanover, NH.
J. Rand.
Available from the National Technical Information Service, Springfield, VA. 22161, as ADA 125503, Price codes: A03 in paper copy, A01 in microfiche. Special Report 82-32, December 1982. 19 p, 5 fig, 1 tab, 11 ref, 2 append.

Descriptors: *Ice, *Water harvesting, *Wells, *Water supply, Greenland, Cold regions, Melting, Pumping, Water management.

The DEW Line Ice Cap Station DYE-2 in Greenland must be raised above the snow line periodically to keep the building above the snow surface. When this procedure can not be repeated, the building can be moved sideways onto new stilts. An alternative proposal is to construct a solid ice foundation made with 2.8 million gallons of water. A system for melting this volume of water and storing it under snow is described. A shaft is drilled with a hot water drill to firn-ice transition. Water formed in the shaft during drilling is pumped to the surface through a hose, passed through a heat exchanger where the temperature is raised to 160 degrees F, and returned to the hole through a second hose. The empty cavity obtained after use of the water can be used for wastewater disposal. The melting period was estimated at 38 days at a cost of $320,000, not including costs of fuel and transportation of fuel and equipment by aircraft. (Cassar-PTT)
W87-00946

COMPOSITION OF SNOW IN PACIFIC COASTAL MOUNTAINS,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W87-01068

WINTERTIME WET AND DRY DEPOSITION IN NORTHERN MICHIGAN,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W87-01069

SEPARATION OF A SNOWMELT HYDROGRAPH BY STREAM CONDUCTANCE,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
D. Kobayashi.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 157-165, April 15, 1986. 4 fig, 6 ref. Ministry of Education (Japan) Grant in Aid for Scientific Research 59020005, 60020003.

Descriptors: *Streams, *Data acquisition, *Snowmelt, *Hydrographs, *Conductance, Runoff, Uryu River, Japan, Subsurface flow, Surface flow.

Measurement of stream conductance and discharge allowed separation of runoff components in the later stages of snowmelt. Hydrographs and data are presented for three weeks, starting March 23, for a site in the headwaters of the Uryu River, Hokkaido Island, Japan. Results showed that subsurface flow dominated surface flow. Plots of stream conductance vs. discharge showed that surface flow peaked about one hour before the total flow in a fully snow-covered watershed. Subsurface peaks were more delayed. When snow-free areas developed, the surface flow peaked after the subsurface flow. When the watershed was totally snow-free, a plot of conductance vs. discharge for a rain storm was similar to that of a completely covered watershed. (Cassar-PTT)
W87-01269

CHARACTERISTICS OF THE ICE AND THERMAL REGIME OF THE GUNT RIVER IN CONNECTION WITH THE DESIGN OF THE PAMIR HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8B.
W87-01368

CALCULATION OF THE SIZE OF ICE HUMMOCKS,
I. E. Kozitskii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 146-149, September 1985. 2 fig, 2 ref. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Ice, *Ice breakup, *Ice cover, *Ice loads, *Structural engineering, Engineering, Ice thickness, Ice formation, Floating ice, Mathematical studies.

Ice hummocks result from shifting of the ice cover during spring movements, and are confined to the shore slope or exposed stretches of the bottom and to shallow waters. At the same time, the shore strip of land is often used for construction, transportation, power engineering, and other economic purposes. Cases have been reported of ice hummocks damaging engineering structures or interrupting the operation of railroads, highways, and oil and gas pipelines. Therefore, the character and extent of this phenomenon should be considered when designing shore engineering structures. This study examines the hydrodynamics of two types of hummocking: partial movement of the ice masses with preservation of a continuous ice cover--movement of the ice cover; free movement of the ice fields and individual floes--drift ice. (Doria-PTT)
W87-01369

SOOT IN THE ARCTIC SNOWPACK: A CAUSE FOR PERTURBATIONS IN RADIATIVE TRANSFER,
A. D. Clarke, and K. J. Noone.
Atmospheric Environment ATENBP, Vol. 19, No. 2, p 2045-2053, December 1985. 5 fig, 2 tab, 24 ref. NSF Grant DPP-8213425.

Descriptors: *Soot, *Arctic snowpack, *Radiative transfer, Arctic radiation, Light absorption, Snow, Ice mass, Filtration, Visible light absorption, Scanning electron micrograph, Arctic haze, Soot aerosol, Snow albedo, Radiation budget.

Measurements of light-absorbing material in the Arctic snowpack for longitudes from 25 E to 160 W are reported. The contributions to light absorption due to natural crustal and soot aerosol are identified by their wavelength dependence. Reductions in Arctic snow albedo of one to several percent appear probable for the soot/ice mass fractions obtained to date. Estimates of the impact of this reduced albedo on the Arctic radiation budget over a season are shown to approximately equal that of the Arctic haze itself. The absorption of shortwave radiation by the springtime snowpack is estimated to be 5-10 percent higher than that of soot-free snow for this data. (Author's abstract)
W87-01438

COMPARISON OF CHEMICAL AND ISOTOPIC HYDROGRAPH SEPARATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2B.
W87-01594

2D. Evaporation and Transpiration

WEEKLY, MONTHLY AND ANNUAL EVAPORATIONS FOR ELK CITY LAKE,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Y. -S. Yu, and H. V. Knapp.
Journal of Hydrology, JHYDA7, Vol. 80, No. 1/2, p 93-110, September 15, 1985. 9 fig, 3 tab, 13 ref.

Descriptors: *Evaporation, *Elk City Lake, *Mathematical models, *Lake evaporation, *Water loss, Pan evaporation, Water supply, Kansas, Evaporation rate, Reservoir evaporation, Drought, Stochastic models.

The mass transfer method is used to estimate weekly evaporations over a period of 11 years for Elk City Lake in Southeast Kansas. A mathematical of a deterministic periodic component and a stochastic component, represented respectively, by a Fourier approximation and an ARMA model. Monthly and annual lake evaporations are also obtained. A comparison of the distribution of the mean monthly lake evaporation with that for Class-A pan evaporation shows the hysteresis effect of heat storage in the lake. The estimated annual lake evaporation at a 2% chance of exceedence is estimated model parameters and the input variables to the mass-transfer equation on evaporation estimates are determined through sensitivity analyses. (Author's abstract)
W87-01168

FURTHER INTERCEPTION STUDIES OF HEATHER USING A WET-SURFACE WEIGHING LYSIMETER SYSTEM,
Institute of Hydrology, Wallingford (England).
R. L. Hall.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 193-210, October 30, 1985. 7 fig, 2 tab, 19 ref.

Descriptors: *Heather, *Interception, *Lysimeter systems, *Wet-surface weighing, Moisture meters, Drainage parameters, Vegetation, Interception models.

The continuing afforestation of Scottish catchments, where the indigenous vegetation is predominantly heather (Calluna vulgaris), has prompted the development of operational catchment response models for water resource management. These models themselves require inputs from physically based research models of interception processes. Measurements were been made of the four canopy parameters required by Rutter type interception models for heather. The values obtained were 5.13 and 0.00085 for the drainage parameters b and k, respectively. 0.13 + or - 0.09 for the free throughfall coefficient p, and 1.1 + or - 0.1 mm and 0.85 + or - 0.1 mm for the canopy capacity S, derived from independent drainage and evaporation experiments, respectively. The difference between the two values of S is significant and represents a real difference between the canopy storage at which drainage ceases and the smaller canopy storage necessary for a completely wet canopy. Studies of the wetting behavior of heather provide evidence to support this hypothesis. (Khumbatta-PTT)
W87-01197

ACID RAIN EFFECTS ON SOIL AND AQUATIC MICROBIAL PROCESSES; THE ECOLOGICAL EFFECTS OF ACID DEPOSITION: PART II:,
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
For primary bibliographic entry see Field 5C.
W87-01208

EFFECT OF SALINITY AND IONIC COMPOSITION ON EVAPORATION: ANALYSIS OF DEAD SEA EVAPORATION PANS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
A. M. Salhotra, E. E. Adams, and D. R. F. Harleman.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1336-1344, September 1985. 5 fig, 9 tab, 26 ref.

Descriptors: *Salinity, *Ions, *Evaporation, *Dead Sea, *Evaporation pans, Chemical properties, Pan evaporation, Evaporation rate, Water properties, Hydrologic budget, Saline lakes, Lakes.

Data from eight evaporation pans containing brines of different salinity and ionic composition were analyzed to quantify the effect of salinity on evaporation. The common procedure of correcting fresh water evaporation by an empirical ratio of salt water to fresh water evaporation rates is shown to be only approximate. A more accurate approach is described, based on the effect of salinity on saturation vapor pressure. The activity coefficient of water was computed based on the pan evaporation data. Various analytical methods to compute the effect of salinity on saturation vapor pressure based on ionic composition of the solution are described and applied with Dead Sea data. These approaches can be applied to many engineering applications, including water balance calculations for saline lakes, salt production ponds, and evaporation ponds used for disposal of saline effluents. (Author's abstract)
W87-01527

URBAN WATER BALANCE: 1. A MODEL FOR DAILY TOTALS,
British Columbia Univ., Vancouver. Dept. of Geography.
For primary bibliographic entry see Field 4C.
W87-01589

URBAN WATER BALANCE: 2. RESULTS FROM A SUBURB OF VANCOUVER, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Geography.
For primary bibliographic entry see Field 4C.
W87-01590

2E. Streamflow and Runoff

HISTORICAL STREAMFLOW SUMMARY: ALBERTA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W87-00873

HISTORICAL STREAMFLOW SUMMARY: BRITISH COLUMBIA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W87-00883

PREDICTION OF FLOW AND POLLUTANT SPREADING IN RIVERS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 5B.
W87-00925

ATCHAFALAYA RIVER DELTA, REPORT 7: ANALYTICAL ANALYSIS OF THE DEVELOPMENT OF THE ATCHAFALAYA RIVER DELTA,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
For primary bibliographic entry see Field 2J.
W87-00942

ARIZONA WATER SUPPLY OUTLOOK AND FEDERAL-STATE-PRIVATE COOPERATIVE SNOW SURVEYS,
Soil Conservation Service, Phoenix, AZ.
For primary bibliographic entry see Field 3B.
W87-00979

HISTORICAL STREAMFLOW SUMMARY: MANITOBA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W87-00981

DISCHARGE CHARACTERISTICS OF LOCAL, DISCONTINUOUS CONTRACTIONS,
Ecole Polytechnique Federale de Lausanne (Switzerland).
For primary bibliographic entry see Field 8B.
W87-01113

PERMANENCE OF DEBRIS DAMS RELATED TO RIVER CHANNEL PROCESSES,
Southampton Univ. (England). Dept. of Geography.
K. J. Gregory, A. M. Gurnell, and C. T. Hill.
Hydrological Sciences Journal HSJODN, Vol. 30, No. 3, p 371-381, September 1985. 4 fig, 17 ref.

Descriptors: *Floods, *Detritus, *Streamflow, *Dams, *England, *Channel morphology, *Traveltime, *Channel flow, *Flow measurement, Catchment areas, Reach, Dam effects, Flow profiles, Channels, River systems, Riverbasins, Vegetation effects, Hydrographs, Flow characteristics, Flow discharge.

Vegetation debris dams in the New Forest, Hampshire, England occur on average every 27 meters of channel. Within less than 12 months, 36 percent of them changed position, changed character or were destroyed. Debris dams influence the timing of flood peaks as they are routed through the channel network. The significance of debris dams in the Highland Waters is examined in relation to channel processes by investigating the time required for well-defined hydrograph peaks to travel along the channel, by measuring reaches surveyed in detail at different stages of the flow and comparing flows before and after dams were cleared from specific reaches of the channel. As dams shift, their significance is even greater than may appear from a single survey at one time. (Michael-PTT)
W87-01115

ANALYTICAL SOLUTION OF LEAF-SHAPED BASIN FLOW,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
N. Agiralioglu.
Hydrological Sciences Journal HSJODN, Vol. 30, No. 3, p 407-424, September 1985. 10 fig, 2 tab, 12 ref.

Descriptors: *Mathematical models, *Hydraulic geometry, *Hydrographs, *Flow rates, *Flow profiles, *Basins, *Runoff, *Kinematic waves, *Rainfall-runoff relationships, *Equilibrium, Diversion, Conversion, Model studies, Prediction, Statistical methods.

Governing equations of flow are solved analytically by using the method of characteristics to predict basin flow runoff for leaf-shaped basin geometry. The flow model is based on kinematic wave theory and uses a diverging-converging model to represent basin geometry. Solutions are presented for both equilibrium and partial-equilibrium conditions. Explicit analytical solutions are obtained for constant rainfall excess. The predictive potential of the flow model is examined using examples with constant rainfall and an impervious surface. Surface runoff hydrographs predicted by the method of characteristics compare favorably with those using the finite difference method. (Author's abstract)
W87-01116

INTERFLOW, OVERLAND FLOW AND LEACHING OF NATURAL NUTRIENTS ON AN ALFISOL SLOPE OF SOUTHERN BAHIA, BRAZIL.
Cacao Research Center, Itabuna (Brazil). Div. of Geosciences.
For primary bibliographic entry see Field 5B.
W87-01167

EFFECT OF SPATIAL VARIABILITY OF EFFECTIVE RAINFALL ON DIRECT RUNOFF BY A GEOMORPHOLOGIC APPROACH,
Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.
For primary bibliographic entry see Field 2A.
W87-01171

SENSITIVITY ANALYSIS, CALIBRATION AND PREDICTIVE UNCERTAINTY OF THE INSTITUE OF HYDROLOGY DISTRIBUTED MODEL,
Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W87-01177

ESTIMATION OF PARAMETERS OF THE DISCRETE, LINEAR, INPUT-OUTPUT MODEL.
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2A.
W87-01178

OUTFLOW SKEWNESS IN NON-SEASONAL LINEAR RESERVOIRS WITH GAMMA-DISTRIBUTED MARKOVIAN INFLOWS,
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 2H.
W87-01184

FLOOD SAMPLES FROM A THREE-PARAMETER LOGNORMAL POPULATION WITH HISTORIC INFORMATION: THE ASYMPTOTIC STANDARD ERROR OF ESTIMATE OF THE T-YEAR FLOOD,
Inland Waters Directorate, Ottawa (Ontario).
R. Condie.
Journal of Hydrology JHYDA7, Vol. 85, 1/2, p 139-150, June 15, 1986. 1 fig, 3 tab, 10 ref, append.

Descriptors: *Flood frequency, *Estimating equations, *Mathematical studies, *Statistical analysis, *Hydrology, Estimating, Statistical methods, Statistics, Hydrometry, Flood peak, Floods.

The series of annual peak flows obtained from a recent continuous flow record, together with any historic floods or information, are treated as a consored sample from a three-parameter lognormal population. The specified floods, the historic information with the censoring threshold, and the parameters to be determined. Maximum likeligood estimators are given as a set of three transcendental equation, which, when solved, hive maximum likelihood estimates of parameters. The T-year flood may be expressed as a function of these parameters and the standard normal variate t. These parameters are subject to sampling variances and covariances, whereas t is not. The inverse variance-covariance matrix is then derived from the logarithmic likelihood function. By inversion, this gives the sampling variances and covariances of the parameters. Entering these in the general equation for the variance of estimate of a function of three variables leads to the asymptotic standard error of estimate of the T-year flood. The method is illustrated by its application to a river with historic data. (Author's abstract)
W87-01185

RELATIONSHIP BETWEEN DATA AND THE PRECISION OF PARAMETER ESTIMATES OF HYDROLOGIC MODELS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2A.
W87-01193

AUTORUN MODEL FOR SYNTHETIC FLOW GENERATION,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
Z. Sen.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 157-170, October 30, 1985. 8 fig, 2 tab, 13 ref.

Descriptors: *Synthetic hydrology, *Mathematical models, *Flow series, Simulation, Hydrological models, Autorun models, Automation, Parametric hydrology.

The practice of generating synthetic hydrologic sequences requires identification of a suitable parsimonious model. For this model, estimates of parameters of the mean, standard deviation and the serial correlation coefficients are obtained from the available historical sequence. The suitability of the identified model may be checked by conventional goodness of fit tests. The wet and dry period characteristics can be used as additional statistics to be produced along with the mean, standard deviation and serial correlation coefficient of the historic data. Wet and dry period statistics can be presented in the synthetic sequences independently from the surplus and deficit magnitudes. This method can be recommended for ephemeral streams in the arid regions of the world, where there are relatively long dry periods with zero discharge and short wet durations with non-zero discharges. The mechanism constructs alternatively wet and dry periods and then corresponding surplus and deficit magnitudes within these. All of the necessary formulations are explicitly derived for the implementation of the model which is applied to four annual flow series observed in Europe. (Khumbatta-PTT)
W87-01195

DETERMINATION OF PARAMETERS BY LINEAR PROGRAMMING, FOR A MODEL WITH N-LINEAR RESERVOIRS IN SERIES,
Academia Sinica, Beijing (China). Inst. of Geography.
G. -T. Wang.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 171-177, October 30, 1985. 1 fig, 3 ref.

Descriptors: *Reservoir yield, *Linear reservoirs, *Linear programming, *Parameters, *Rainfall-runoff models, Hydrological models, Multireservoir networks.

A conceptual model of the surface runoff system consisting of N equal linear reservoirs in series, has been widely used for transforming rainfall excess into runoff. A more general model would be obtained by relaxing the conditions of equality of the reservoirs. To solve a rainfall-runoff problem through the use of conceptual hydrological models usually involves determining the instantaneous unit hydrograph (IUH) from rainfall and runoff records by using moment matching. It is necessary to convert the IUH into a unit hydrograph of finite duration D, DUH. For this the S-curve is used.

The structural relationship between the model with N-linear reservoirs in series and its discrete form was determined and the parameters of the discrete form derived directly from rainfall and runoff records by linear programming. (Khumbatta-PTT)
W87-01196

IMPROVEMENTS IN THE INVERSE ESTIMATION METHOD OF EFFECTIVE RAINFALL FROM RUNOFF,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-01201

MECHANISMS INFLUENCING THE CIRCULATION AND DISTRIBUTION OF WATER MASS IN A MEDIUM RESIDENCE-TIME LAKE,
National Water Research Inst., Vancouver (British Columbia).
For primary bibliographic entry see Field 2H.
W87-01226

IN SITU PARTICLE GENERATION IN A SOUTHERN SWEDISH STREAM,
Lund Univ. (Sweden). Limnological Inst.
For primary bibliographic entry see Field 2H.
W87-01232

WOODY RIPARIAN VEGETATION OF A LAKE SUPERIOR TRIBUTARY,
Minnesota Univ.-Duluth. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-01235

FISH FAUNAL STRUCTURE IN AN OZARK STREAM: STABILITY, PERSISTENCE AND A CATASTROPHIC FLOOD,
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 2H.
W87-01253

DYNAMIC ROUGHNESS AND THE TRANSITION BETWEEN WIND WAVE REGIMES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 8B.
W87-01271

CONFRONTING DROUGHT: THE FRENCH EXPERIENCE (FAIRE FACE A LA SECHERESSE: L'EXPERIENCE FRANCAISE),
Agence Financiere de Bassin Seine-Normandie, Paris (France).
For primary bibliographic entry see Field 3F.
W87-01331

ANALYSIS AND MODELLING OF RUNOFF IN THE SAHEL REGION (OURSI POND, BURKINA FASO) (ANALYSE ET MODELISATION DU RUISSELLEMENT EN REGION SAHELIENNE (MARE D'OURSI, BURKINA FASO),
Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast). Centre d'Adiopodoume.
For primary bibliographic entry see Field 2B.
W87-01333

INVESTIGATION OF BRANCHED CHANNELS OF DELTAS,
For primary bibliographic entry see Field 8B.
W87-01352

CONSIDERATION OF THE INTRASEASONAL VARIATION OF THE PROBABILITY OF MAXIMUM DISCHARGES,
For primary bibliographic entry see Field 2A.
W87-01353

ENERGY LOSSES OF A CHANNEL FLOW UNDER CONDITIONS OF OVERFLOW ONTO A FLOODPLAIN,
For primary bibliographic entry see Field 8B.
W87-01389

REGIMES OF PASSAGE OF HIGH FLOODS THROUGH THE CASCADE OF HYDROSTATIONS ON THE VOLGA AND KAMA RIVERS,
A. E. Asarin.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 357-360, January 1986. 2 fig. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Hydrological regime, *Floods, *Hydraulic structures, *Kama River, *Volga River, Water level, Reservoirs, Flood peak, Flood flow, Flow, Runoff, USSR.

The experience of operating reservoirs and hydrostations on the Volga and Kama Rivers (USSR) shows that the time has come to perform research and development works for estimating the conditions for passage of high floods past hydrostations of the Volga-Kama cascade. These works should develop refined regulations for operating reservoirs of the cascade during high floods (e.g., a total inflow of more than 200 cu km) and assess the possibility of passage of high waters along the cascade under conditions of delivering the runoff of northern rivers to the Volga. The investigations should include a refinement of the parameters of the flood runoff of the Volga, Kama, and local inflow between hydrostations with consideration of hydrological observations of recent years. (Doria-PTT)
W87-01398

EFFECTS OF CLEARCUTTING ON RAIN-ON-SNOW RUNOFF IN WESTERN OREGON: A NEW LOOK AT OLD STUDIES,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 4C.
W87-01449

STUDY ON GENERATION OF PERIODICAL LARGE SURFACE EDDIES IN A COMPOSITE CHANNEL FLOW,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
N. Tamai, T. Asaeda, and H. Ikeda.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1129-1138, July 1986. 14 fig, 2 tab, 21 ref.

Descriptors: *Eddies, *Channel flow, *Water currents, Floodplain, Shear, Interfacial zone, Mathematical studies, Mathematical analysis, Wave number, Wave activity.

A set of comparative experiments were used to identify a predominant factor in the generation of large eddies on the water surface at the interface between the main channel and the floodplain in a composite channel flow. In the present work, four experiments performed had the following results: (1) There exists a shear layer at the interface between the main channel and the floodplain. The most fundamental cause of large eddies on the water surface in the interfacial zone amounts to the shear layer in a lateral velocity profile according to experiments in three kinds of open channels and in a closed channel; (2) In the interfacial zone the flow has complicated three-dimensional structures. One is a strong upward flow originating from the corner of the floodplain, which is thought to be a swirl induced by the interaction between a large eddy on the water surface and the channel bed. The other is an inclined roller eddy on the floodplain bed, spreading horizontally toward the middle of the main channel. These two kinds of motion occur periodically in association with the large two-dimensional eddies on the water surface. Therefore, the generation frequency of large eddies on the water surface is intrinsically the same as that of large vortices in two-dimensional shear layers; and (3) the periodicity of the large eddies on the water surface is explained by linear stability theory for a two-dimensional free shear flow. The wave number of the large two-dimensional eddies, not only in an open channel, but also in a closed channel, is interpreted as that of the most amplified wave in the lateral shear layer at the interface. (Lantz-PTT)
W87-01453

STRUCTURE AND DYNAMICS OF THE FRENCH UPPER RHONE ECOSYSTEMS: 28. PRODUCTION ESTIMATION OF GAMMARIDS (STRUCTURE ET FONCTIONNEMENT DES ECOSYSTEMES DU HAUT-RHONE FRANCAIS. 28. ESTIMATION DE PRODUCTION DE GAMMARES),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W87-01461

TOWARDS A THEORY OF MACROINVERTEBRATE COMMUNITY STRUCTURE IN STREAM ECOSYSTEMS,
Idaho State Univ., Pocatello. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-01481

REGIONAL HYDROLOGIC ANALYSIS: 1. ORDINARY, WEIGHTED, AND GENERALIZED LEAST SQUARES COMPARED,
Geological Survey, Reston, VA.
J. R. Stedinger, and G. D. Tasker.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1421-1432, September 1985. 4 fig, 2 tab, 21 ref, 2 append.

Descriptors: *Regional analysis, *Hydrology, *Least squares method, *Stream gaging networks, *Mathematical studies, *Estimating equations, Streamflow, Stream gages, Monte Carlo method, Streamflow forecasting, Forecasting.

Streamflow gaging networks provide hydrologic information for deriving relationships between physiographic variables and streamflow statistics. The performance of ordinary, weighted, and generalized least squares estimators of the parameters of such regional hydrologic relationships is compared in situations where the avaiiable streamflow records at gaged sites can be of different and widely varying lengths and concurrent flows at different sites are cross-correlated. A Monte Carlo study illustrates the performance of an ordinary least squares (OLS) procedure and an operational generalized least squares (GLS) procedure which accounts for and directly estimates the precision of the predictive model being fit. The GLS procedure provided more accurate parameter estimates, better estimates of the accuracy with which the regression model's parameters were being estimated, and almost unbiased estimates of the model error. The OLS approach can provide very distorted estimates of the model's predictive precision (model error) and the precision with which the regression model's parameters are being estimated. A weighted least squares procedure which neglects the cross correlations among concurrent flows does as well as the GLS procedure when the cross correlation among concurrent flows is relatively modest. The Monte Carlo examples also explore the value of streamflow records of different lengths in regionalization studies. (Author's abstract)
W87-01536

EFFECTS OF SUSPENDED SEDIMENT ON THE OPEN-CHANNEL VELOCITY DISTRIBUTION,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W87-01587

PERIODIC GAMMA AUTOREGRESSIVE PROCESSES FOR OPERATIONAL HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
B. Fernandez, and J. D. Salas.

Water Resources Research WRERAO, Vol. 22, No. 10, p 1385-1396, September 1986. 9 fig, 10 tab, 44 ref. NSF Grants CEE-8110782 and INT-8412739.

Descriptors: *Model studies, *Autoregressive processes, *Mathematical studies, *Hydrologic models, Hydrologic properties, Regression analysis, Mathematical models, Simulation analysis.

A number of models have been suggested for hydrologic time series in general and streamflow series in particular. Most of them are normal autoregressive (AR) of order 1 with either constant or periodic parameters. Since generally hydrologic time series are nonnormal (skewed), transformations have been suggested to make the series approximately normal. A new class of univariate models is proposed here, which incorporates skewed and correlation properties within the model structure, without the necessity of transformations. Such models assume a gamma marginal distribution and a constant or periodic autoregressive structure. The models may be additive gamma, multiplicative gamma, or a mixed model, which incorporates properties of both additive and multiplicative models . The gamma models were tested and compared in relation to (transformed) normal AR models by computer simulation studies based on five weekly streamflow series with samples varying from 35 to 40 years of record. The results show that the new class of gamma models compares favorably with respect to the normal models in reproducing the basic statistics usually analyzed for streamflow simulation. (Author's abstract)
W87-01588

DISCRETE CONCEPTUALIZATION OF A VOLTERRA SERIES MODEL FOR SURFACE RUNOFF,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
For primary bibliographic entry see Field 2A.
W87-01591

LOW-VELOCITY MEASUREMENT IN WATER,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 7B.
W87-01598

REGIONAL HYDROLOGIC ANALYSIS, 2, MODEL-ERROR ESTIMATORS, ESTIMATION OF SIGMA AND LOG-PEARSON TYPE 3 DISTRIBUTIONS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and G. D. Tasker.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1487-1499, September 1986. 4 fig, 4 tab, 15 ref, 2 append.

Descriptors: *Mathematical models, *Regional analysis, *Hydrologic aspects, *Model studies, *Statistical analysis, *Statistical models, Least squares method, Regression analysis, Streamflow, Catchment areas, Error analysis.

For a number of cases, weighted and generalized least squares regression procedures were shown to provide better estimators of the parameters of models of hydrologic statistics as a function of drainage basin characteristics. These procedures require estimation of the true model's standard error of prediction. Evaluated here are three model error estimators for weighted least squares (WLS) regression and two for generalized least squares (GLS) regression. The generalized mean square estimator previously employed was nearly unbiased, and comparable in accuracy to, and easier to compute than, the maximum likelihood estimator. GLS and WLS regression estimators of the log-streamflows' standard deviation are substantially more accurate than ordinary least squares estimators. Finally, the consequences and impact of nonlognormal streamflows were evaluated. In the cases considered, GLS procedures continued to perform well even when the normality assumption was violated. (Author's abstract)
W87-01599

STORM RUNOFF GENERATION IN HUMID HEADWATER CATCHMENTS: 1. WHERE DOES THE WATER COME FROM,
New Zealand Forest Service, Rotorua. Forest Research Inst.
A. J. Pearce, M. K. Stewart, and M. G. Sklash.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1263-1272, August 1986. 6 fig, 76 ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, *Headwaters, *Humid areas, *Westland, *New Zealand, Catchments, Rainfall, Soil water, Streamflow, Tawhai State Forest, Groundwater, Hydrographs, Flow profiles.

Production of storm runoff in highly responsive catchments is not well understood. Reported is a comprehensive set of hydrometric and natural tracer data for rainfall, soil water, and streamflow for catchments in the Tawhai State Forest, Westland, New Zealand, which reveal some of the important thin (<1 m) permeable soils. Long-term (1977-1980) weekly observations of oxygen 18, electrical conductivity, and chloride in the stream, groundwater, and rain in the main study catchment indicate that catchment outflow reflects a well-mixed reservoir with a mean residence time of approximately 4 months. A preliminary storm hydrograph separation using oxygen 18 (for a storm hydrograph exceeded by only 22% of events since 1979) indicates that only 3% of storm runoff could be considered 'new' (i.e., current storm) water. Rapid subsurface flow, such as macropore flow, of new water therefore cannot explain the streamflow response in the study area. (See also W87-01629) (Author's abstract)
W87-01628

STORM RUNOFF GENERATION IN HUMID HEADWATER CATCHMENTS: 2. A CASE STUDY OF HILLSLOPE AND LOW-ORDER STREAM RESPONSE,
Windsor Univ. (Ontario). Dept. of Geology.
M. G. Sklash, M. K. Stewart, and A. J. Pearce.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1273-1282, August 1986. 12 fig, 6 tab, 14 ref.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Headwaters, *Humid areas, *Westland, *New Zealand, Catchments, Rainfall, Soil water, Streamflow, Tawai State Forest, Groundwater, Hydrographs, Flow profiles.

Previous hydrometric and dye tracer studies in Maimai 8, a highly responsive catchment in the Tawhai State Forest, Westland, New Zealand, suggest that storm runoff generation is by rapid transmission of 'new' (current storm rain) water to the stream via macropores. Hydrometric and natural tracer (oxygen 18, deuterium, electrical conductivity, chloride) observations were used in two first- and one second-order stream and in six throughflow pits, to evaluate the roles of 'old' (stored) and new water during three storm events (return periods from 4 weeks to 3 months) in September 1983. New water contributions were small (<25% of the hydrograph volume) and could be accounted for by saturation overland flow. Hillslope response varied areally but all sites issued old water-dominated throughflow. Ridge top sites had larger new water contributions (approximately 30-40%) than valley sites (<10%). Macropore flow of new water therefore cannot explain streamflow or throughflow response in the Maimai catchments. (See also W87-01628) (Author's abstract)
W87-01629

HISTORICAL STREAMFLOW SUMMARY: SASKATCHEWAN, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W87-01767

2F. Groundwater

RESPONSE OF A DENSE FLUID UNDER PUMPING STRESS,
G. M. Wisniewski, G. P. Lennon, J. F. Villaume, and C. L. Young.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 226-237, 9 fig, 2 tab, 6 ref.

Descriptors: *Density, *Hydrodynamics, *Pumping, Oil recovery, Saline water intrusion, Hazardous wastes, Aquifers, Upconing, Stroudsburg, Pennsylvania.

Investigations of two-fluid flow in a porous medium have traditionally focused on problems related to hydrocarbon recovery, salinity intrusion and geothermal energy. Recently, understanding the response of a two-fluid system became an important factor in the recovery of a hazardous fluid from a contaminated aquifer system. In this study, laboratory experiments were conducted in physical models to investigate the simultaneous flow of two immiscible fluids in a porous medium. The study employed the use of two physical models which allowed visualization of the flow field. Specifically, the model tests had three objectives: (1) investigate the response to the interface to pumping stresses in the less dense and more dense fluid, (2) demonstrate the use of deliberate upconing as a means of improving recovery of the denser fluid, and (3) compare the recovery efficiency of alternative pumping schemes. These experimental results demonstrate conclusively that deliberate upconing can be an effective means of improving the recovery of a denser fluid in an unconfined porous medium. The results show that the recovery rate can be doubled or even tripled over the conventional recovery scheme without upconing. Field tests at a coal tar contamination site in Stroudsburg, PA confirmed the findings of this laboratory investigation and recommendations from this study helped to more than double recovery rates. (See also W87-00832) (Lantz-PTT)
W87-00847

FIRST CANADIAN/AMERICAN CONFERENCE ON HYDROGEOLOGY: PRACTICAL APPLICATIONS OF GROUND WATER GEOCHEMISTRY.
Research Council of Alberta, Edmonton.
Available from the National Water Well Association, Worthington, Ohio 43085. June 22-26, 1984, Banff, Alberta. 1985. Edited by Brian Hitchon and Edward I. Wallick. 323 p.

Descriptors: *Geohydrology, *Geochemistry, *Conferences, *Groundwater hydrology, Information exchange, Groundwater movement, Chemical analysis, Water sampling, Models studies, Statistical analysis, Isotope studies, Microbiological studies, Hydrogeology.

Presented in this volume are the papers, abstracts and field trip notes of a meeting concerning hydrogeology and groundwater geochemistry, which was jointly sponsored by the Alberta Research Council and the National Water Well Association. Topics discussed fall into seven general categories: (1) fluid flow and hydrochemical evolution; (2) chemical principles; (3) groundwater sampling and analysis; (4) geochemical modeling; (5) statistical treatment; (6) isotope geochemistry; and (7) microbial aspects of groundwater. (See also W87-00893 thru W87-00911) (Lantz-PTT)
W87-00892

ROLE OF REGIONAL GRAVITY FLOW IN THE CHEMICAL AND THERMAL EVOLUTION OF GROUND WATER,
Alberta Univ., Edmonton. Dept. of Geology.
J. Toth.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 3-39, 45 fig, 8 tab, 68 ref.

Descriptors: *Groundwater movement, *Groundwater chemistry, *Gravity flow, *Chemical evolution, *Thermal evolution, *Water chemistry, *Geochemistry, Groundwater budget, Steady flow, Laplace equation, Diffusion equations, Mathematical studies, Geohydrology.

The relationship between the gravity flow of groundwater and its physical environment is described by the theory of regional groundwater flow. This theory is predicated upon the concept of regional hydraulic continuity of the rock framework and expressed by an adapted version of the diffusion equation. For steady-state flow the diffusion equation. reduces to the Laplace Equation, which may be solved for various boundary conditions to obtain idealized flow patterns in natural drainage basins. Solutions to transient forms of the diffusion equation are used to calculate time rates and durations of pore pressure changes at depth in response to changing boundary conditions at the basins' surface, and thus to evaluate paleo-flow patterns or to predict future ones. Theoretically or empirically evaluated flow patterns may be coupled with fundamental processes of rock-water interaction to postulate expectable effects and manifestations of basinal groundwater flow. The paper presents numerous real life examples to illustrate and verify the postulated effects and manifestations, including: hydrologic, hydraulic, chemical, mineralogic, vegetal, soil and rock mechanical, geomorphologic, thermal, and ore and hydrocarbon accumulation phenomena. Although this paper addresses the general aspects of hydrogeochemistry and transport of chemical mass and heat in groundwater systems, its primary purpose is to provide the understanding of regional groundwater flow that is prerequisite to the other papers in this volume. (See also W87-00892) (Lantz-PTT)
W87-00893

OCCURRENCE OF DISSOLVED OXYGEN AND THE ORIGIN OF FERRIC HYDROXIDE-CEMENTED HARDBEDS IN THE PATUXENT AQUIFER, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2K.
W87-00894

HYDROCHEMICAL PROCESSES IN THE REGIONAL GROUND WATER DISCHARGE ZONES OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA,
Victoria Dept. of Minerals and Energy, Melbourne (Australia).
P. G. Macumber.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 47-63, 14 fig, 9 tab, 16 ref.

Descriptors: *Groundwater geochemistry, *Diagenesis, *Chemical properties, *Groundwater discharge, *Murray Basin, *Australia, Groundwater movement, Saline water, Hydrogen ion concentration, Chlorides, Chemical analysis, Nickel, Uranium, Copper, Brine.

The Murray Basin of southeastern Australia is a closed groundwater basin, in which regional groundwater flow passes from recharge areas in the highlands to regional discharge areas on the plains and in the mallee. In the mallee, discharge occurs in salt playas (salinas) scattered throughout the linear dune field and in the large groundwater discharge complexes - the boinkas. Concentration of saline lake waters followed by their subsequent reflux into the groundwater systems has resulted in the formation of large groundwater brine bodies (1,000 sq km in area with salinities up to 290,000 mg/l) in response to climatic changes over the last 32,000 years. The low pH and relatively high chlorinities of the regional groundwater enhances the transport of metal ions from upbasin source areas to the discharge zones where they may precipitate under the influence of Eh/pH variations in the aquifer and at the spring zone/lake interface. This provides a model for both synthetic and epigenetic base metal mineralization in certain provinces where redbeds, evaporites and metals such as U-Cu-Ni are found. Groundwater-deposited iron formations are found extensively throughout the discharge zones, and this can be shown to have been an ongoing process for much of the Quaternary Period. (See also W87-00892) (Author's abstract)
W87-00895

CHEMICAL EQUILIBRIUM AND KINETICS OF GEOCHEMICAL PROCESSES IN GROUND WATER STUDIES,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
D. Langmuir, and J. Mahoney.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 69-95, 24 fig, 6 tab, 68 ref.

Descriptors: *Groundwater geochemistry, *Chemical equilibrium, *Geochemistry, *Kinetics, Groundwater chemistry, Geohydrology, Chemical reactions, Confined groundwater, Earth-water interfaces.

In this paper, the principles of equilibrium (including adsorption) and of kinetics are addressed and illustrated with practical applications. Geochemical reactions or processes can alter the hydrologic properties of a rock. Such reactions (or the lack of them) can also render a water fit or unfit for certain uses. An understanding of equilibrium and kinetic concepts as they apply to water-rock systems can greatly improve one's ability to predict the chemical and isotopic composition of groundwater, and so to better manage groundwater resources. For these reasons, hydrologists need to know some groundwater geochemistry. Chemical equilibrium defines the boundary conditions: i.e., what are the maximum or minimum possible concentrations of some dissolved species likely to be. Chemical kinetics defines how long it takes to reach equilibrium and by what reaction pathways it is reached. Only chemical equilibrium concepts are needed to understand groundwater chemistry when the rates of reactions of interest are much faster than groundwater residence times in a particular water/rock system. Thus, such concepts have been most usefully applied in deep basin artesian groundwater studies. When reaction rates are comparable to or less than residence times, both kinetic and equilibrium concepts apply. This is particularly the case in shallow water table systems. Chemical equilibrium concepts, including adsorption, have successfully explained the chemical behavior of may groundwater systems. In contrast, the understanding of geochemical kinetics is in relative infancy, so that only the simplest kinetic concepts have been usefully applied in groundwater studies. (See also W87-00892) (Lantz-PTT)
W87-00896

SOLUBILITY CONTROLS OF FLUORINE, BARIUM AND CHROMIUM IN GROUND WATER IN ALLUVIAL BASINS OF ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
F. N. Robertson.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 96-102, 3 fig, 2 tab, 19 ref.

Descriptors: *Groundwater geochemistry, *Solubility, *Fluorine, *Barium, *Chromium, *Groundwater quality, Alluvial basins, Arizona, Chemical analysis, Trace elements, Model studies, Equilibrium, Geohydrology, Sorption, Minerals.

Several trace elements occur in the groundwater in the majority of the alluvial basins of Arizona in concentrations that commonly exceed state and federal contaminant levels. The basin-fill sediments were derived from igneous and metamorphic rocks of the surrounding mountains and contain many trace elements. Under geochemical conditions favorable for dissolution, these elements may enter the natural water system. Important factors that affect the occurrence and mobilization of elements in groundwater are (1) availability in the rock environment, (2) pH and oxidation potential of the groundwater system, (3) exchange or sorption-desorption reactions, and (4) mineral equilibria controls. Equilibrium models and geologic information were used to determine controls that affect occurrence and solubility of three elements - fluoride, barium and hexavalent ciromium. These elements occur naturally in the groundwater and range from traces to concentrations of five to 10 times the maximum contaminant level. Availability in the rock environment appears optimum for barium, chromium and probably for fluorine. Mineral equilibria and equilibrium solubilities appear to be major solubility controls for barium and hexavalent chromium. Fluorine solubility may be controlled by availability, exchange or sorption reactions, and mineral equilibria. (See also W87-00892) (Author's abstract)
W87-00897

GEOCHEMICAL MODELS OF THE RELATION BETWEEN WATER QUALITY AND MINERALOGY IN COAL-PRODUCING STRATA OF SOUTHWESTERN VIRGINIA,
Geological Survey, Richmond, VA. Water Resources Div.
J. D. Powell.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 103-112, 10 tab, 10 ref.

Descriptors: *Groundwater geochemistry, *Acid mine water, *Geochemistry, *Groundwater quality, *Minerals, *Coal, *Virginia, Geohydrology, Silicates, Carbonates, Pyrite, Oxidation, Cation exchange, Minerals, Chemical analysis, Water quality, Model studies.

The geochemical processes controlling groundwater chemistry in the coal-producing strata of southwestern Virginia include hydrolysis of silicates, dissolution of carbonates, oxidation of pyrite, cation exchange, and precipitation of secondary minerals, kaolinite and goethite. Three reaction models are used to account for the observed water chemistry. The models derive sulfate from pyrite, iron from pyrite and siderite, calcium from plagioclase and calcite, sodium from plagioclase and cation exchange, magnesium from chlorite, and carbon from carbon dioxide, calcite and siderite. Kaolinite, chalcedony and goethite are formed authigenically. Carbon-13 data define the relative contributions of carbon sources to models. Comparison of adjacent unmined and mined basins indicates that surface mining significantly increases the weathering reaction of pyrite in contrast to weathering reactions of other minerals. However, in the area studied, the buffering capacity present appears to be sufficient to neutralize acidity produced by reactive pyrite. (See also W87-00892) (Lantz-PTT)
W87-00898

SAMPLING AND ANALYSIS OF SUBSURFACE WATER,
For primary bibliographic entry see Field 5B.
W87-00899

PERFORMANCE EVALUATION OF RCRA INDICATOR PARAMETERS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5B.
W87-00900

GEOCHEMICAL MODELING: A COMPARISON OF FORWARD AND INVERSE METHODS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W87-00901

MODELING OF GROUND WATER FLOW AND COMPOSITION,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground

Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 178-188, 5 fig, 1 tab, 36 ref.

Descriptors: *Groundwater geochemistry, *Path of pollutants, *Groundwater movement, *Chemical analysis, *Physical analysis, Radioactive wastes, Groundwater, Diffusion, Mixing, Advection, Adsorption, Mineral dissolution, Radioactivity, Radioactive half-life, Mathematical analysis, Tracers.

The transport of mass in a groundwater system is controlled by an array of physical and chemical processes. In terms of the physical processes, diffusion, mechanical mixing and advection are the most important. Included with the chemical processes are reactions including adsorption, mineral dissolution and precipitation and radioactive decay. The dispersion-convection equation provides the framework for representing processes in a quantitative way. Solution of this equation or sets of these equations describes the changes in ion concentration in groundwater as a function of space and time. The application of these principles to field problems has unfortunately been hindered by the numerical difficulties involved with actually solving the dispersion-convection equation, especially when complex chemical interactions are included. Previous studies are used to illustrate how models for flow and mass transport can be applied to a problem of groundwater contamination and the level of sophistication that has been achieved in including reactions in transport models. (See also W87-00892) (Lantz-PTT)
W87-00902

GEOCHEMISTRY AND ALTERATION PROCESSES OF URANIUM TAILINGS IN GROUND WATER, GRANTS MINERAL BELT, NEW MEXICO,
New Mexico Environmental Improvement Agency, Santa Fe.
For primary bibliographic entry see Field 5B.
W87-00903

ENVIRONMENTAL ISOTOPES: PRINCIPLES AND APPLICATIONS IN GROUND WATER GEOCHEMICAL STUDIES IN ALBERTA, CANADA,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
E. I. Wallick, H. R. Krouse, and A. Shakur.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 249-266, 23 fig, 6 tab, 35 ref.

Descriptors: *Environmental isotopes, *Groundwater dating, *Geochemistry, *Alberta, Isotope studies, Hydrogen, Oxygen radioisotopes, Carbon radioisotopes, Sulfur radioisotopes, Deuterium, Protium, Tritium, Groundwater, Tracers.

Isotopic ratio determinations of hydrogen, oxygen, carbon and sulfur are among the most useful of parameters in the study of groundwater geochemical systems. Hydrogen has two stable isotopes, protium and deuterium, having masses one and two, and atomic abundances of 99.985 and 0.15%, respectively. The main mass-dependent processes by which hydrogen isotope abundances are altered are evaporation and condensation of water in the hydrological cycle of the earth. Tritium (mass three, half-life 12.3 yrs) is produced by cosmic rays in the upper atmosphere and in thermonuclear bomb explosions. Tritium levels are affected mainly by losses due to radioactive decay, through exchange with atmospheric water vapor, and through dilution in the oceans. Oxygen has three stable isotopes having masses 16 (most abundant), 17 (.01 %), and 18 (.08%). The main mass-dependent processes that affect the abundance of oxygen isotopes are evaporation, condensation and exchange reactions. Carbon has three isotopes of environmental importance having masses 12, 13 and 14. The average abundances for the two stable nuclides are 98.9 and 1.1%, respectively, while carbon-14 is radioactive and has a half-life of 5,730 years. Inasmuch as carbon is the building block of life, biological processes play the dominant role in the fractionation of carbon isotopes. Sulfur consists of four stable isotopes having masses 32 (95.01%), 33 (0.75%), 34 (4.21%) and 36 (.02%). Sulfur is also important in the biological cycle and the wide range in valence states, (-2 to +6), and the fact that sulfur compounds occur in all three phases and in organic, as well as inorganic compounds, make is especially prone to isotopic fractionation. (See also W87-00892) (Lantz-PTT)
W87-00908

GROUND WATER AGE DETERMINATIONS, PICEANCE CREEK BASIN, COLORADO,
Geological Survey, Denver, CO.
B. A. Kimball.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 267-283, 5 fig, 7 tab, 42 ref.

Descriptors: *Groundwater dating, *Piceance Creek basin, *Colorado, *Isotope studies, Green River, Model studies, Carbon radioisotopes, Chemical analysis, Minerals, Salts, Geochemsitry, Groundwater.

A set of 22 samples was collected for the determination of stable isotopes and carbon-14 in the Piceance Creek Basin of northwestern Colorado. Samples were from the upper and lower aquifers of the Eocene Green River and Uinta Formations. Stable-isotope determinations were used with major-ion data to define chemical mass-balance reaction models. These models provided a means to correct analytical carbon-14 ages for the effects of dilution and fractionation, resulting from dissolution and precipitation of carbonate minerals, oxidation of organic matter and transfer of carbon-dioxide gas. Equations were included to account for the dissolution of saline minerals and the evaporative concentration of solutes in some of the samples. Many models were evaluated for each sample, but not all were consistent with thermodynamic, mineralogic or isotopic constraints on the system. Although a unique reaction could not be defined for each sample, the acceptable reaction models allow large corrections to the analytical carbon-14 ages. The adjusted ages range from about 750 years for wells near the recharge areas to more than 20,000 years from wells farther down the hydrologic gradient. Variations in the stable isotopes give evidence of mixing of modern water being recharged to the system with water recharged several thousand years ago during colder climatic regimes. Geochemical interpretations from isotope variations confirm conceptual models of the complex flow system. (See also W87-00892) (Author's abstract)
W87-00909

MAJOR ION AND ISOTOPE GEOCHEMISTRY OF GROUND WATER IN CLAYEY TILL, NORTHWESTERN WISCONSIN, USA,
Wisconsin Geological and Natural History Survey, Madison.
K. R. Bradbury.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 284-289, 8 fig, 5 ref.

Descriptors: *Groundwater movement, *Geochemistry, *Isotope studies, *Ion transport, *Clayey Till, Wisconsin, Chemical analysis, Water analysis, Piezometry, Hydraulic gradient, Tritium, Oxygen, Deuterium, Carbon radioisotopes, Saturation.

Hydrogeologic and geochemical data, including hydraulic head profiles, field determinations of permeability, major ion water chemistry, and environmental isotopes (18-O, 2-H, 3-H), characterize the age and vertical movement of groundwater through thick, jointed, clayey tills in northwestern Wisconsin. Two study sites, near Superior and Ashland, Wisconsin, are located in thick sequences of late Wisconsin tills. Vertically nested piezometers installed to depths of up to 30 m at the sites indicate downward hydraulic gradients, and till permeabilities are on the order of 10 to the minus 8th cm/sec. Tritium (3-H) is not detectable below 3 m, indicating that groundwater at or below this depth recharged prior to 1952. At Superior, 18-O shows a steady negative shift from about -10% (SMOW) at 3 m, characteristic of modern precipitation, to -16% at 24 m, characteristic of a much cooler climate. At both sites, groundwater is oversaturated with respect to calcite and dolomite near the surface, but saturation indices decrease with depth. Concentrations of Ca(2+), Mg(2+) and HCO3(-) also decrease with depth, while Cl(-) consistently increases. Concentrations of all ions are most variable in the upper 15 m of the profiles, possibly a result of weathering processes or fracture flow in the shallow zone. Results of this study suggest that original pore water has remained in a portion of the till profile since deposition of the till 9,500 to 10,000 years ago. Radiocarbon (14-C) sampling is currently underway to place absolute dates on pore water in the profiles. (See also W87-00892) (Author's abstract)
W87-00910

SULFUR CYCLE IN WESTERN NORTH DAKOTA COAL MINES,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-00912

WIPP HYDROLOGY PROGRAM WASTE ISOLATION PILOT PLANT SOUTHEASTERN NEW MEXICO: HYDROLOGIC DATA REPORT 2.
INTERA Technologies, Inc., Austin, TX.
Contractor Report SAND85-7263, December 1985. 512 p, 100 fig, 18 tab, 5 ref, 9 append. Contract DE-AC04-76DP00789.

Descriptors: *Aquifer testing, *Groundwater, *Data collections, *Water level, Pumping tests, Hydrologic data, Waste Isolation Pilot Plant, New Mexico, Wells, Observation wells, Radioactive wastes, Hydrologic data collections.

Data on aquifer tests and water level measurement was collected at three locations at the Waste Isolation Pilot Plant site, New Mexico, from 1983-1985. Data include results of pumping and slug tests, water levels, drawdown, pressures, and discharge measurement. The automated Data Acquisition System was used to collect much of the information. (Cassar-PTT)
W87-00952

INFLUENCE OF LEACH RATE AND OTHER PARAMETERS ON GROUNDWATER MIGRATION,
Dames and Moore, White Plains, NY.
For primary bibliographic entry see Field 5B.
W87-00954

FRACTURE PERMEABILITY AND GROUNDWATER FLOW IN CLAYEY TILL NEAR SASKATOON, SASKATCHEWAN,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
C. K. Keller, G. van der Kamp, and J.A. Cherry.
Canadian Geotechnology Journal CGJOAH, Vol. 23, No. 2, p 229-240, May 1986. 10 fig, 1 tab, 29 ref. Natural Sciences and Engineering Research Council (Canada) Grants A8184 and G1372.

Descriptors: *Fracture permeability, *Groundwater movement, *Saskatoon, *Till, *Weathering, *Permeability coefficient, Canada, Specific storage, Slug tests, Consolidation tests, Pond, Seepage, Aquifers, Pumping.

Field and laboratory studies of a clayey unweathered glacial till have shown that its bulk permeability exceeds its matrix permeability by two orders of magnitude. The till in question is 6 m thick and appears to be unweathered and unfractured. It is overlain by 12 m of weathered and highly fractured till. Results of consolidation tests on the unweathered till indicate a mean vertical hydraulic conductivity of 3.5 x 10 to the minus eleventh power meter/sec and a mean specific storage of 0.00013 per meter. Slug tests yield a horizontal hydraulic conductivity of about 5 x 10 to the minus

ninth power meter/sec. Drawdowns in the till in response to pumping from the aquifer below indicate a vertical hydraulic diffusivity of 0.000045 sq m/sec. Slug test results combined with specific storage results from consolidation tests indicate a similar value for horizontal hydraulic diffusivity of 0.00004 sq m/sec. Geochemical patterns, tritium data, and measured seepage fluxes from an ephemeral pond also indicate that the vertical conductivity of the unweathered till is much higher than the value obtained from the consolidation tests. The data show that the unweathered till has significant vertical and horizontal fracture permeability. (Author's abstract)
W87-01041

AQUIFER PARAMETER PREDICTION IN LEAKY AQUIFERS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. M. Aral.
Journal of Hydrology, JHYDA7, Vol. 80, No. 1/2, p 19-44, September 15, 1985. 11 fig, 39 ref.

Descriptors: *Aquifers, *Leaky aquifers, *Georgia, *Algorithms, *Hydrology, *Groundwater movement, Optimization, Georgia, Model studies, Transmissivity, Seepage.

The finite element-least-squares optimization algorithm is utilized to identify the hydrogeologic field parameters of a multi-layer aquifer system. The technique developed relies on accurate steady state piezometric head data for each aquifer in the multi-layered system. The least-squares iterative approach systematically adjusts the local transmissivity values and the resistance parameters of the confining piezometric head values at several locations. This is an iterative approach which automates the trial and error model calibration process and extends it to a multi-layer system. The technique is applied to a field problem in Georgia. Results compared favorably with the expected values of locally measured transmissivities in both aquifers. The spatial distribution of these transmissivities was also remarkably consistent with field data. The algorithm shows promise as a practical tool and a definite alternative to the manual trial and error model calibration approach. (Doria-PTT)
W87-01166

APPLICATION OF A LAKE-WATERSHED MODEL FOR THE DETERMINATION OF WATER BALANCE,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2H.
W87-01170

ESTIMATE OF DISPERSION IN AN UNSATURATED AQUIFER,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-01172

CHARACTERISTICS OF AN UNUSUAL HIGHLY ALKALINE WATER FROM THE MAQARIN AREA, NORTHERN JORDAN,
Jordan Univ., Amman. Dept. of Geology and Mineralogy.
H. N. Khoury, E. Salameh, and Q. Abdul-Jaber.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 79-91, October 30, 1985. 6 fig, 3 tab, 19 ref.

Descriptors: *Water chemistry, *Groundwater quality, Alkaline water, *Jordan, *Well water, Chemical properties, Water, Meteoric water, Water properties, Wells, Minerals.

An unusual highly alkaline natural water (ph = 12.5) is recorded in adits and wells from the Maqarin area, northern Jordan. It is a meteoric calcium hydroxide-sulfate type of water that passes through metamorphosed rocks rich in portlandite, gypsum, and other soluble, low-temperature minerals, rich in base metals concentration. The water is unsuitable for domestic or irrigation use because of a high pH, Ca, OH, SO4, and trace metal content. The hydration of lime is responsible for the high pH value of this water. The high calcium and base metals concentration is related to the effect of spontaneous combustion of organic matter in the Bituminous Marl Formation. A low-temperature transformation process is still active as a result of reaction of these waters with the rocks. (Doria-PTT)
W87-01173

GROUNDWATER RECHARGE ESTIMATION USING CHLORIDE, DEUTERIUM AND OXYGEN-18 PROFILES IN THE DEEP COASTAL SANDS OF WESTERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, and M. W. Hughes.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 933-109, October 30, 1985. 6 fig, 3 tab, 20 ref.

Descriptors: *Groundwater recharge, *Chlorides, *Evapotranspiration, *Deuterium, *Oxygen isotopes, *Sand, *Australia, Recharge, Model studies, Groundwater.

Depth distributions of environmental chloride, deuterium, and oxygen-18 in deep sands were monitored to estimate average recharge to groundwater in Western Australia. Average areal recharge is approximately 15% of average precipitation (775 mm/yr) based on the conservation of chloride. While the chloride concentration of groundwater was relatively uniform, there was a considerable spatial variability in the depth distribution of chloride in the unsaturated zone. Possibly some 50% of the total annual recharge occurs via movement of water through preferred pathways, thus bypassing the soil matrix. Stable isotope (deuterium and oxygen-18) data show that there has been some isotopic enrichment due to evaporation of the rainfall, but the extent of enrichment appears to be too small to estimate recharge rates reliably. It is argued that relatively small isotopic enrichment occurs in the system studied since the direct evaporation from soil is a rather small component of the total evapotranspiration. The observations on the depth distribution of isotopes qualitatively support the presence of a bimodal system for water movement through the profile, as was suggested by the analysis of chloride data. (Doria-PTT)
W87-01174

TRANSIENT WELL FLOW IN LEAKY MULTIPLE-AQUIFER SYSTEM,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
C. J. Hemker.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 111-126, October 30, 1985. 4 fig, 21 ref.

Descriptors: *Wells, *Flow, *Aquifers, *Transient well flow, *Leaky aquifers, *Groundwater movement, *Aquifer characteristics, Confined aquifers, Model studies, Hydraulics, Drawdown, Unconfined aquifers, Partially penetrating wells.

A previously developed eigenvalue analysis approach to groundwater flow in leaky multiple aquifers is used to derive exact solutions for transient aquifers. Equations are presented for the drawdown distribution in systems of infinite extent, caused by wells penetrating one or more of the aquifers completely and discharging each layer at a constant rate. Since the solution obtained may be regarded as a combined analytical-numerical technique, a type of one-dimensional modeling can be applied to find approximate solutions for several complicating conditions. Numerical evaluations are presented as time-drawdown curves and include effects of storage in the aquitard, unconfined conditions, partially penetrating wells, and stratified aquifers. The outcome of calculations for relatively simple systems compares very well with published results. The proposed multilayer solution can be a valuable tool in aquifer test evaluation, since it provides the analytical expression required for the application of existing computer methods to the determination of aquifer characteristics. (Author's abstract)
W87-01175

APPLYING LOGIC PROGRAMMING IN HYDROLOGY. DEFINITION OF A PROGRAM FOR THE AUTOMATIC INTERPRETATION OF PUMPING TEST DATA,
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 7C.
W87-01176

USE OF THE CHLORIDE ION IN DETERMINING HYDROLOGIC-BASIN WATER BUDGETS - A 3-YEAR CASE STUDY IN THE SAN JUAN MOUNTAINS, COLORADO, U.S.A.,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2A.
W87-01180

PRELIMINARY ASSESSMENT OF THE REGIONAL DISPERSIVITY OF SELECTED BASALT FLOWS AT THE HANFORD SITE, WASHINGTON, U.S.A.,
Texas A and M Univ., College Station. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-01186

STUDY OF TRACER MOVEMENT THROUGH UNSATURATED SAND,
Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
F. de Smedt, F. Wauters, and J. Sevilla.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 169-181, June 15, 1986. 11 fig, 1 tab, 28 ref.

Descriptors: *Soil water movement, *Tracers, *Sand, *Solute transport, *Hydrodynamics, *Unsaturated flow, Flow, Radioactive tracers, Tritium, Radioisotopes, Flow characteristics.

A solute displacement experiement, using tritium as a tracer, was conducted under saturated water flow conditions in a sand column. Analysis of the observed effluent concentration resulted in an estimated dispersivity of 0.094 cm. Solute displacement experiments under saturated water flow conditions were conducted by leaching the column intermittently on a daily basis with constant amounts of water. As soon as the amount drained from the column was equal to the daily input, tritium as added to the infiltrating water for some period. The parameters of the hydrodynamic dispersion equation were fitted to the observed effluent concentrations. Very large dispersion coefficients were obtained with a dispersivity of about 7.3 cm. A possible explanation is the presence of immobile water pockets during unsaturated flow. For all experiments, it was found that about 36% of the water in the unsaturated column could be considered as immobile. The exchange of solute between the mobile and immobile phases explains the large dispersion observed in the experiments conducted under unsaturated conditions. (Author's abstract)
W87-01187

PROCESSING OF GEOPHYSICAL WELL LOGS BY MICROCOMPUTERS AS APPLIED TO THE SOLUTION OF HYDROGEOLOGICAL PROBLEMS,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
For primary bibliographic entry see Field 7B.
W87-01189

IMPROVED METHOD OF LEAST-SQUARES PARAMETER ESTIMATION WITH PUMPING-TEST DATA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley, A. D. Sneyd, and P. D. Hill.
Journal of Hydrology JHYDA7, Vol. 80, No. 3/4, p 271-281, October 15, 1985. 4 fig, 3 tab, 11 ref, append.

Descriptors: *Least squares analysis, *Aquifer characteristics, *Storativity, *Pumping tests,

Transmissivity, Aquifers, Estimation error, Mathematical studies, Water-bearing formations.

The traditional graphical methods of pumping-test analysis have been replaced in part by computerized procedures, most of which are concerned with estimation of storativity and transmissivity using a least squares criterion of fit. Unfortunately, the various algorithms proposed contain a weakness in that there is no guarantee of convergence to the global minimum of the squared deviation function; the calculated values of transmissivity and storativity may not correspond to the true least-squares estimates. Rerunning the least-squares routines with different starting values provides some check against suboptimal minima. It would be more desirable to have a procedure which always produced the true least-squares estimates in a single run. This note presents one such method applicable to the estimation of storativity and transmissivity given unsteady radial flow in a horizontal confined homogeneous aquifer. This is dependent upon finding the lowest point on a mathematical surface. The accuracy of the estimate is dependent on good initial values since there is no guarantee that such surfaces do not contain local minima. The estimation procedure can be improved by converting the two-dimensional minimization problem into an equivalent form in one dimension, which can easily be evaluated through any given feasible interval. This avoids the requirement of initial estimates and always returns the true estimates after a single computational sequence. Examples are given of the application of the method together with a simple model for the determination of estimation error. (Khumbatta-PTT)
W87-01190

EFFECT OF SALINITY-DEPENDENT HYDRAULIC CONDUCTIVITY ON SALTWATER INTRUSION EPISODES,
Army Engineer District, Fort Worth, TX.
E. Mehnert, and A. A. Jennings.
Journal of Hydrology JHYDA7, Vol.80, No. 3/4, p 283-297, October 15, 1985. 10 fig, 28 ref. NSF Grant CME81-05549.

Descriptors: *Hydraulic conductivity, *Saline water intrusion, *Saltwater intrusion, *Salinity, Permeability coefficient, Saline-freshwater interfaces, Saline water, Dispersion, Aquifers.

The intrusion of saltwater into coastal aquifers is a naturally occurring phenomenon. A broad zone of dispersion is considered to exist. The zone of dispersion moves seaward during periods of high freshwater recharge and the seaward flux varies with tidal oscillations. A mechanism capable of inducing a change in hydraulic conductivity and its potential effect on saltwater intrusion episodes is discussed. The ionic strength of percolating water can greatly alter a soil's hydraulic conductivity due to dispersion and/or swelling of clay particles by several orders of magnitude. The potential effects of salinity-dependent changes in hydraulic conductivity during saltwater intrusions were analyzed. Results show that this can control the extent to which brackish water can penetrate a coastal aquifer. This can also increase the width of the dispersed salt front, and can lead to a much greater circulation of saltwater within the intruding saltwater toe. These results may help to explain field observations that have previously been attributed to dispersivity and domain heterogeneity. (Khumbatta-PTT)
W87-01191

UNSTEADY FLOW TO A WELL TAPPING TWO AQUIFERS SEPARATED BY AN AQUICLUDE,
National Inst. of Hydrology, Roorkee (India).
G. C. Mishra, M. D. Nautiyal, and S. Chandra.
Journal of Hydrology JHYDA7, Vol. 82, No. 3/4, p 357-369, December 30, 1985. 7 fig, 2 tab, 7 ref.

Descriptors: *Aquifers, *Aquicludes, *Unsteady flow, *Wells, Confined aquifers, Groundwater, Hydraulics, Well water, Artesian wells.

Water wells are generally constructed by tapping more than one aquifer in order to have dependable yield. Unsteady flow to a well tapping two aquifers separated by aquiclude was analyzed, using the integral transform technique. A finite difference formulation of the equation of groundwater flow in three dimensions was developed. Using a discrete kernel approach, a methodology was determined to analyze unsteady flow to a multi-aquifer well. The contribution of an individual aquifer to well discharge was estimated when the well is pumped at a constant rate. The contribution of an aquifer is governed by its hydraulic diffusivity value. If both the aquifers have equal diffusivity, the aquifers' contributions are independent proportional to the respective transmissivity value. At early stages of pumping the major contribution is by the aquifer whose diffusivity is lower. At large time values, the contribution by each aquifer is in proportion to its transmissivity value. (Khumbatta-PTT)
W87-01199

DISCHARGE CALCULATION FROM EARLY DRAWDOWN DATA IN LARGE-DIAMETER WELLS,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
Z. Sen.
Journal of Hydrology JHYDA7, Vol. 83, No. 1/2, p 45-48, January 15, 1986. 2 fig, 2 tab, 5 ref.

Descriptors: *Discharge, *Drawdown data, *Wells, *Large-diameter wells, Groundwater, Artesian wells, Discharge capacity, Pumping tests.

Various ways to measure discharge from large diameter wells are known, such as the commercial water meter, Parshal flume, container, orifice weir, orifice bucket and jet stream methods. A common requirement for the application of these methods in the field is that the end of the water pipe should be reachable. In addition, the pipe should be completely sealed to prevent leakage. A common difficulty in discharge measurement is that the leading pipe from the well branches out into many small pipes, thus making the above mentioned direct methods inapplicable. A proposed method for calculating discharge, which may be used in cases where direct methods are impractical, was used for five large-diameter wells in Wadi Qudaid, western Saudi Arabia. The data points used in the study for discharge estimates are early drawdown measurements which fall on a 45 degree straight line, indicating that most water is derived from well storage. The individual relative errors were $<10\%$. The average error for five wells was about 3%. (Khumbatta-PTT)
W87-01200

EFFECTS AND IMPLICATION OF TIDES AND RAINFALL ON THE CIRCULATION OF WATER WITHIN SALT MARSH SEDIMENTS,
Institute of Oceanographic Sciences, Taunton (England).
For primary bibliographic entry see Field 2L.
W87-01227

EXPERIMENTAL AND NUMERICAL STUDY OF WATER AND SOLUTE INFILTRATION IN LAYERED POROUS MEDIA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Hydromechanik und Wasserwirtschaft.
F. Stauffer, and T. Dracos.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 9-34, April 15, 1986. 24 fig, 3 tab, 22 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Solute transport, Porous media, Aquifers, Recharge, Groundwater recharge, Infiltration.

Flow and transport processes occurring in natural and artificial recharge of phreatic aquifers were studied. Only two-dimensional flow in a vertical plane and conservative tracers were considered. The porous medium was a horizontally layered sand packing. Once the infiltration front reached the capillary fringe, the experiments showed a rapid change in the phreatic surface slope and thus a fast increase of the flow rate in the saturated domain. Outflow of the infiltrated solute was observed at much later times. This fast response was due to capillary phenomena, that is the hysteresis in the soil moisture characteristics dependent on the initial conditions in the capillary zone. Solute transport was dominated by advective transport mechanisms which are strongly influenced by the layering of the sand packing. (Cassar-PTT)
W87-01262

TRANSVERSE DISPERSION FROM AN ORIGINALLY SHARP FRESH-SALT INTERFACE CAUSED BY SHEAR FLOW,
Technische Hogeschool Delft (Netherlands).
G. De Josselin DeJong, and C. J. Van Duijn.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 55-79, April 1986. 11 fig, 15 ref, 3 append.

Descriptors: *Transversal dispersion, *Saline-freshwater interfaces, *Shear flow, *Mathematical models, *Nonlinear distribution, Velocity, Anisotropy, Molecular diffusion.

The influence of transversal dispersion and molecular diffusion on the distribution of salt in a plane flow through a homogenous porous medium was studied. The dispersion depends on the velocity and the velocity on the distribution of salt, a nonlinear phenomenon. The situation considered leads to a differential equation with the character of nonlinear diffusion. Properties of a similarity solution were discussed. The interpretation of these mathematical results in terms of their hydrological significance is given for a number of solved examples. Examples are given where the molecular diffusion can be disregarded with respect to the transversal dispersion. (Author's abstract)
W87-01264

GEOSTATISTICAL ANALYSIS OF GEOELECTRIC ESTIMATES FOR SPECIFIC CAPACITY,
Tiszadata Consulting Engineers, Budapest (Hungary).
A. Bardossy, I. Bogardi, and W. E. Kelly.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 81-95, April 15, 1986. 17 fig, 17 ref.

Descriptors: *Groundwater, *Data acquisition, *Geophysics, *Electrical studies, Geoelectric estimates, Specific capacity, Hydrology, Aquifer characteristics, Wells, Resistivity.

A geostatistical method is presented for predicting the areal distribution of specific capacity from a network of surface resistivity measurements and a limited number of known specific capacities obtained from well performance data. The quality of the prediction is characterized by the standard deviation of the estimation error. The effect of the following main factors can be quantified: the spatial variability of specific capacity, the number and location of the known specific capacities and resistivity measurements, and the regression error of the relationship between resistivity and specific capacity. The methodology is illustrated by a realistic numerical example where 30 well data and 116 resistivity values are available for a 16 sq km aquifer. In this example the use of resistivity data considerably improves the quality of the prediction despite the relatively loose relationship between resistivity and specific capacity ($r = 0.80$). The calculation can be performed on a microcomputer, and the methodology can be extended to solve the corresponding network design problem. (Author's abstract)
W87-01265

PERTURBATION ANALYSIS OF FLOWS IN A THREE-LAYER CONFINED-UNCONFINED AQUIFER SYSTEM,
Lagos Univ. (Nigeria).
O. Lafe.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 97-105, April 15, 1986. 4 fig, 9 ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater movement, Confined aquifers, Unconfined aquifers, Mathematical studies, Perturbation analysis, Hydraulics.

Perturbed solutions of the coupled non-linear equations governing essentially horizontal flows in a rigid three-layer confined-unconfined aquifer system are obtained in the form of asymptotic series in the dimensionless leakage parameters of the intervening semi-pervious strata. The uppermost layer is phreatic while the remaining two are semi-confined. The solutions are particularized for the flow towards a fully penetrating well which is screened for the bottommost confined aquifer. A numerical example for this case is added. (Author's abstract)
W87-01266

INFLUENCE OF THE KARST SPRING SUBMERGENCE ON THE KARST AQUIFER REGIME,
Karst Water Research Inst., Trebinje (Yugoslavia).
P. Milanovic.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 141-156, April 15, 1986. 8 fig, 3 ref.

Descriptors: *Groundwater, *Environmental effects, *Aquifers, *Karst, *Springs, Dam construction, Reservoirs, Seismic properties, Trebisnjica River, Water table fluctuations, Geohydrology.

Construction of the 123 m high Grancarevo Dam flooded a large, permanent karst spring to a depth of as much as 75 m. Velocity of underground flows in this aquifer is 0.9-14.0 cm per sec. Water table fluctuations are very rapid with amplitudes up to 120 m. The influence of flooding the springs on the karst aquifer regime was studied with correlation analysis of the index of previous precipitation reservoir water level, underground water level in the immediate vicinity of the spring and in the distant parts of the aquifer, and the inflow into the reservoir. Mutual dependence was shown for most of the parameters analyzed. Flooding of the springs has some influence on the hydrological conditions of the upstream polje and the surface in the immediate tributary area. Formation of an underground reservoir in the karst aquifer was indicated. Induced seismicity was detected during reservoir filling. (Cassar-PTT)
W87-01268

SATURATED HYDRAULIC CONDUCTIVITIES OF GRANITIC MATERIALS OF THE IDAHO BATHOLITH,
Forest Service, Ogden, UT. Intermountain Research Station.
W. F. Megahan, and J. L. Clayton.
Journal of Hydrology, JHYDA7, Vol. 84, No. 1/2, p 167-180, April 15, 1986. 7 fig, 1 tab, 30 ref.

Descriptors: *Groundwater, *Geohydrology, *Aquifers, *Hydraulic conductivity, Idaho, Granite, Batholith, Boreholes, Subsurface flow, Shallow flow, Mountains, Weathering, Rocks, Hydrology, Groundwater movement.

Saturated hydraulic conductivity (K sub sat) of granitic bedrock in the Idaho batholith was determined using a borehole pressure testing technique. Tests were conducted at approximately 1.6 m depth increments ranging from about 1.6 m to an average maximum depth of 7.8 m. A total of 58 valid tests were obtained in nine holes located at five sites in a 145 km long transect line running north-south in the southwest quarter of the batholith. Sites represent a wide range in rock fracturing and weathering properties. Seismograph profiles were also run at each test hole. A conditional probability analysis showed that K sub sat values were lognormally distributed with a lower bound at zero. Values for K sub sat were unrelated to depth, rock matrix porosity, seismic velocity, or rock fracture density. However, K sub sat did vary with rock weathering characteristics. Conductivity was lowest in weathered rock probably because of restricted fracture apertures. The second least weathered rock class had the highest average K sub sat. There was a general decrease in K sub sat with increased weathering through the remaining five weathering classes even though rock porosity and fracture density increased with rock weathering. This inverse trend in K sub sat with increased weathering is the result of progressively increasing clay formation and mineral expansion that restricts flow in both fractures and the rock matrix. K sub sat for bedrock averages an order of magnitude less than K sub sat for soil cores and two orders of magnitude less than K sub sat obtained by tracer tests during subsurface flow making shallow, subsurface flow a major hydrologic process at many locations on the steep mountain slopes. (Author's abstract)
W87-01270

NATURAL SINK FOR NITRATES TRANSPORTED BY GROUNDWATER: THE ALDER FOREST, (UNE STATION D'EPURATION NATURELLE DES NITRATES TRANSPORTES PAR LES NAPPES ALLUVIALES: L'AULNAIE GLUTINEUSE),
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 5B.
W87-01343

STRUCTURAL CONDITIONS OF THE CARBONATE AQUIFERS IN SOUTHERN CHINA (GUANGXI PROVINCE, GUILIN AREA), (CONDITIONS STRUCTURALES DES AQUIFERES CARBONATES DE CHINE MERIDIONALE (PROVINCE DE GUANGXI, REGION DE GUILIN)),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
C. Drogue, Y. Daoxian, P. Bidaux, and S. -Y. Zhou.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 302, No. 15, p 975-978, April 21, 1986. 3 fig, 9 ref.

Descriptors: *Reservoirs, *Remote sensing, *Geohydrology, *Aquifers, *Guangxi, *China, *Geologic fractures, *Karst hydrology, Geologic history, Mesozoic era, Cenozoic era, Carbonates, Groundwater, Water potentials.

The Devonian-Carboniferous limestones and dolomites of the Guangxi area constitute karstic aquifers whose fissural structure originates from three tectonic episodes of the Mesozoic and Cenozoic Ages. The fracture trends which have a probable hydrogeologic role are also identifiable by ERTS. The aquifers are of interest as a potential resource, as well as from the point of view of their origins and hydraulic characteristics. (Airone-PTT)
W87-01346

SIZE FRACTIONATION TECHNIQUES IN THE DETERMINATION OF ELEMENTS ASSOCIATED WITH PARTICULATE OR COLLOIDAL MATERIAL IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-01415

CONJUGATE GRADIENT FINITE ELEMENT MODEL OF FLOW FOR LARGE MULTIAQUIFER SYSTEMS,
Padua Univ. (Italy). Inst. of Applied Mathematics.
G. Gambolati, F. Sartoretto, and F. Uliana.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1003-1015, July 1986. 13 fig, 1 tab, 30 ref.

Descriptors: *Aquifer systems, *Finite element method, *Mathematical models, *Flow profiles, *Groundwater movement, Modified conjugate gradients, Mathematical studies, Aquifers.

A quasi three-dimensional finite element model based on the conjugate gradient technique was developed and applied to the analysis of subsurface flow occurring in complex heterogeneous multiaquifer systems. Transient leakage across the aquitards is fully taken into consideration using the favorable features of the modified conjugate gradients (MCG), which prove to be a very efficient tool for the solution of the integrodifferential model. The high performance of MCG results from two combined factors: (1) the diagonal dominance of the assembled finite element matrix, which is emphasized by the integral contributions; (2) the essential reducibility of the matrix for a wide range of time step values, which is due to the virtual decoupling of the aquifer equations. The preconditioning of the conjugate gradient scheme is therefore improved, and a good covergence occurs after a number of iterations smaller than (N/n) to the 1/2 power, N and n being the overall number of nodes and aquifers, respectively. The computational cost of the model is generally low, and its relative efficiency tends to increase for small to moderate time steps and for complex multiaquifer systems where several interconnected aquifers are simulated (Author's abstract)
W87-01440

SIMULATIONS OF TWO-WELL TRACER TESTS IN STRATIFIED AQUIFERS AT THE CHALK RIVER AND THE MOBILE SITES,
GeoTrans, Inc., Herndon, VA.
P. S. Huyakorn, P. F. Andersen, F. J. Molz, O. Guven, and J. G. Melville.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1016-1030, July 1986. 12 fig, 4 tab, 15 ref. EPA Agreement No. CR 810704-02.

Descriptors: *Simulation analysis, *Tracers, *Stratified flow, *Aquifers, *Chalk River, *Mobile, Canada, Alabama, Hydraulic conductivity, *Groundwater movement, Flow profile, Model studies, Mathematical analysis, Observation wells, Monitoring, Injection wells.

A simulation study of two-well injection-withdrawal tracer tests in stratified granular aquifers was conducted near the Chalk River Nuclear Laboratories in Canada and at a site in Mobile, Alabama. Field data and test conditions at these sites are substantially different in terms of vertical distributions of hydraulic conductivity, well spacings, flow rates, test durations, and tracer travel distances. Furthermore, the test at the Chalk River site was conducted in a recirculating mode, whereas the test at the Mobile site was conducted in a nonrecirculating mode. Simulations of these tests were performed in three dimensions using a curvilinear finite element model. The simulations incorporated measured vertical variations in relative hydraulic conductivity, and local dispersivity values, that are small fractions (between 1/1000 and 1/100) of the spacing between the injection and the withdrawal wells. The local dispersivities are used to account for local hydrodynamic dispersion and are chosen independently so that they are not affected by the scales of the tests. Interpretation of the results is made in conjunction with measured breakthrough curves at the withdrawal well and multilevel observation wells. For the Chalk River site, predicted and measured breakthrough curves show a declining trend but the field data plot does not. For the Mobile site, predicted and measured breakthrough curves at the withdrawal well show similar trends throughout the entire test duration and are in good agreement overall. Model predictions of the effect of hydraulic conductivity stratification on temporal distributions of concentration are generally consistent with data from multilevel observation wells at both sites. (Author's abstract)
W87-01441

PERFORMANCE, ANALYSIS, AND SIMULATION OF A TWO-WELL TRACER TEST AT THE MOBILE SITE,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, O. Guven, J. G. Melville, R. D. Crocker, and K. T. Matteson.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1031-1037, July 1986. 10 fig, 1 tab, 15 ref. EPA Contract No. CR 810704-02.

Descriptors: *Simulation analysis, *Tracers, *Mobile, *Groundwater movement, Performance evaluation, Alabama, Flow profile, Mathematical analysis, Bromide, Injection well, Hydrodynamics, Dispersion.

During the late summer of 1984 a two-well tracer test was performed which involved travel distances of 38.3 m to 90 m. A bromide tracer slug

was injected at one well while groundwater was simultaneously pumped from the other well. The two-well test, which required 32 days to complete, was then simulated using a three-dimensional advection-dispersion model with a longitudinal dispersivity of 0.15 m, a transverse dispersivity of 0.05 m, and the permeability distribution being measured independently in a single-well test. (Single-well test results, which involved a travel distance of 5.5 m, indicated that the hydraulic conductivity varied by about a factor of 4 throughout the aquifer thickness.) The two-well test simulation, made without knowledge of the test results, and without any calibration, was remarkably good. Local hydrodynamic dispersion was negligible, so that the concentration versus time breakthrough at the withdrawal well could be simulated just as well with a quasi-three-dimensional advection model having zero hydrodynamic dispersion. This implies that over the travel distances applicable to the two-well test, the spreading of the slug in the aquifer depended mainly on macroscopic velocity variations that were quantifiable in terms of the inferred permeability distribution. (Author's abstract)
W87-01442

LABORATORY STUDIES OF GAS FLOW THROUGH A SINGLE NATURAL FRACTURE,
Golder Associates, Inc., Redmond, WA.
For primary bibliographic entry see Field 8E.
W87-01443

CASE STUDY OF A CHEMICAL SPILL: POLYCHLORINATED BIPHENYLS (PCBS), 3. PCB SORPTION AND RETARDATION IN SOIL UNDERLYING THE SITE,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-01444

STEADY INFILTRATION FROM BURIED DISCS AND OTHER SOURCES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 5B.
W87-01445

ROLE OF GROUNDWATER IN DELAYING LAKE ACIDIFICATION,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W87-01450

FREQUENCY DOMAIN ANALYSIS OF GROUNDWATER QUALITY FLUCTUATIONS: INTERPRETATION OF FIELD DATA,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-01452

ESTIMATION OF TDS IN SAND AQUIFER WATER THROUGH RESISTIVITY LOG,
China Geoexploration and Waterwell Engineering Corp., Karachi (Pakistan).
Y. A. Guo.
Ground Water GRWAAP, Vol. 24, No. 5, p 598-600, September-October 1986. 3 fig, 1 tab, 2 ref.

Descriptors: *Sand aquifers, *Total dissolved solids, *Resistivity, *Borehole geophysics, Mathematical studies, Geohydrology, Groundwater quality, Electrodes.

An empirical relationship between aquifer resistivity and total dissolved solids (TDS) in the groundwater of sand aquifers has been observed. Aquifer resistivity is determined through a resistivity log in a lateral array, with an electrode spacing of 2.5 meters. Using the relationship, the TDS in each aquifer can be estimated separately from its resistivity log curve. The TDS values thus arrived at since 1968, when compared with actual TDS content in groundwater of more than a thousand sand aquifers encounted in 400 wells drilled in the North China Plain, showed errors ranging up to + or - 0.3 gm/L, except in the case of two wells where it was 0.8 and 0.9 gm/L, respectively. (Author's abstract)
W87-01490

VERTICAL FLOW IN HEAVILY EXPLOITED HARD ROCK AND ALLUVIAL AQUIFERS,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
Ground Water GRWAAP, Vol. 24, No. 5, p 601-608, September-October, 1986. 6 fig, 8 ref.

Descriptors: *Vertical flow, *Groundwater movement, *Alluvial aquifers, *Rocks, Clay, Wells, Mathematical studies, Mathematical models, Groundwater depletion.

An examination of the flow in heavily exploited alluvial and hard rock aquifers demonstrated that vertical components of flow are of great importance. In a typical example of an alluvial aquifer, most of the discharge from tube wells originated from the phreatic surface flowing vertically through clay layers to the well screens. A second study of a hard rock aquifer indicated that a tube well in a fractured zone draws water horizontally from the fractured zone, but this water is supplied by vertical flow from the weathered zone. The suitability of different types of mathematical models to represent heavily exploited hard rock and alluvial aquifers is also considered. (Author's abstract)
W87-01491

DETERMINISTIC MODELING OF DISPERSION IN HETEROGENEOUS PERMEABLE MEDIA,
South Dakota School of Mines and Technology, Rapid City. Dept. of Geology and Geological Engineering.
For primary bibliographic entry see Field 5B.
W87-01492

CAPTURE-ZONE TYPE CURVES: A TOOL FOR AQUIFER CLEANUP,
Lawrence Berkeley Lab., CA. Earth Sciences Div.
For primary bibliographic entry see Field 5G.
W87-01493

HYDROCHEMICAL FACIES EVALUATION IN UMM ER RADHUMA LIMESTONE, EASTERN SAUDI ARABIA,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrogeology.
Z. Sen, and A. alDakheel.
Ground Water GRWAAP, Vol. 24, No. 5, p 626-635, September-October, 1986. 16 fig, 3 tab, 16 ref.

Descriptors: *Water chemistry, *Groundwater quality, *Umm Er Radhuma, *Limestone, *Geochemistry, *Saudi Arabia, Aquifers, Water analysis, Mathematical analysis, Graphical analysis, Sodium chloride, Calcium sulfate, Calcite, Anhydrite, Chemical analysis.

The hydrochemical characteristics of the Umm Er Radhuma aquifer in the eastern part of Saudi Arabia, were investigated by means of extensive data processing in the form of spatial variations, histograms, equivalents per million percentage histograms, linear relationships between various composite variables, as well as equilibrium studies. Equilibrium studies of groundwater chemistry of the UER aquifer indicate that most waters are of calcium sulfate or sodium chloride types. The aquifer is almost completely oversaturated with calcite but partially undersaturated in the northern part with anhydrite. The graphs developed should prove of use in groundwater studies in other parts of the world. (Lantz-PTT)
W87-01494

HYDRODYNAMIC BEHAVIOR OF THE PUELCHE AQUIFER IN MATANZA RIVER BASIN,
Buenos Aires Univ. (Argentina). Plains Hydrology Inst.
M. P. Auge.
Ground Water GRWAAP, Vol. 24, No. 5, p 636-642, September-October, 1986. 5 fig, 1 tab, 6 ref.

Descriptors: *Hydrodynamics, *Puelche Aquifer, *Matanza River, *Epipuelche Aquifer, *Groundwater movement, Hydraulic gradient, Potentiometric level, Recharge, Flow pattern, Aquifers, Argentina.

By comparison between the isophreatic and isopiestic contours, a general similarity exists between the potentiometric levels, the hydraulic gradients, and the distribution of local recharge and discharge areas of both the Puelche and Epipuelche aquifers. There is also an occurrence between the surface water and groundwater divides, the latter acting as a hydrological barrier which prevents groundwater inflows to the Matanza basin from neighboring basins. The volume of water flowing away from the Puelche aquifer, by underground lateral movement in the northeastern section of the basin, is 20,000 cu m/d (5.3 Mgal/d). This yield is supplied by the Epipuelche aquifer through vertical downward leakage, because the Puelche: (1) does not crop out within the study area, (2) does not receive water recharge from underground flows from neighboring basins, and (3) is a semi-confined aquifer. From comparison between piezometric and phreatimetric maps, curves of equal difference of hydraulic head between both aquifers can be constructed. From these, it is determined that the Puelche potentiometric surface is lower than the Epipuelche (water table) in 75% of the groundwater basin area. Therefore, of the total of the groundwater basin area (1,600 sq km = 620 sq mi), the Puelche is recharged by the Epipuelche over 1,200 sq km (465 sq mi). In 25% of the area (400 sq km = 155 sq mi), the Puelche exhibits positive levels relative to the Epipuelche, hence discharging into the latter. (Author's abstract)
W87-01495

INCREDIBLE TALE OF TEXASGULF WELL 7 AND FRACTURE PERMEABILITY, PARADOX BASIN, UTAH,
Wyoming Univ., Laramie. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 8E.
W87-01496

LEAKING PIPES RECHARGE GROUND WATER,
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 4B.
W87-01497

COMPUTER PROGRAM FOR GENERATING TWO-DIMENSIONAL FIELDS OF AUTOCORRELATED PARAMETERS,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 7B.
W87-01498

MICROCOMPUTER PACKAGE FOR DETERMINING OPTIMAL WELL DISCHARGE,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 7B.
W87-01499

FINITE ANALYTIC NUMERICAL SOLUTION FOR TWO-DIMENSIONAL GROUNDWATER SOLUTE TRANSPORT,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
J. C. Hwang, C.-J. Chen, M. Sheikhoslami, and B. K. Panigrahi.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1354-1360, September 1985. 3 fig, 1 tab, 19 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Numerical analysis, *Groundwater, *Solute transport, *Finite analytic method, Mathematical studies.

A new numerical method called the finite analytic (FA) method is used to solve a groundwater solute transport problem. The method incorporates a local analytic solution in the numerical solution of the partial differential equation. When the local analytic solution is evaluated at a given nodal point, it gives an algebraic relationship between a nodal value in an element and its neighboring nodal points. The assembly of the linear system equations results in a tridiagonal matrix. The advantages of using efficient iterative techniques for solving tridiagonal matrices are equally applicable to the FA method. The automatic localized upstream shift and the analytic property of the FA method eliminate the difficulty of numerical dispersion locally and suppress the overall numerical dispersion for a large Peclet number. For a small Peclet number, the method yields excellent results compared with the analytic solution. For a large Peclet number, solutions are oscillation-free with some degree of numerical dispersion. The results are comparable with those obtained using the upstream weighted finite element method. (Author's abstract)
W87-01529

TYPE CURVE ANALYSIS OF INERTIAL EFFECTS IN THE RESPONSE OF A WELL TO A SLUG TEST,
Geological Survey, Lakewood, CO. Water Resources Div.
K. L. Kipp, Jr.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1397-1408, September 1985. 5 fig, 2 tab, 21 ref.

Descriptors: *Groundwater movement, *Type curve analysis, *Slug tests, *Test wells, *Well hydraulics, Water level, Confined aquifers, Aquifers, Inertial effects, Wells, Numerical analysis, Transmissivity, Data interpretation, Mathematical studies.

The water level response to a slug or bailer test is evaluated in a well completed in a confined aquifer taking into account well-bore storage and inertial effects of the water column in the well. The response range, from overdamped with negligible inertial effects to damped oscillation, was covered employing numerical inversions of the Laplace-transform solution. By scaling the time with respect to the undamped natural period of the well-aquifer system, and by using the damping parameter for a second-order damped, inertial-elastic system, a set of type curves was constructed that enables water level response data from a slug or bailer test to be analyzed under conditions where the inertial parameter is large. Values of transmissivity and effective static water column length can be determined from an estimate of storage coefficient. The numerical solution and resulting type curves cover the transition range between the limiting cases of negligible inertial effects and of damped oscillation that have been treated by others. Two examples of slug test analysis show that precise results depend on accurate measurements of water level displacement. (Author's abstract)
W87-01534

UNSTEADY GROUNDWATER DRAWDOWN IN EMBANKMENTS,
Ministry of Works and Development, Rotorua (New Zealand).
For primary bibliographic entry see Field 8D.
W87-01576

CAN UNSATURATED FLOW DURING GRAVITY DRAINAGE BE REPRESENTED BY BOULTON'S FORMULATION,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
A. I. el Kadi, and W. Brutsaert.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1361-1366, September 1986. 6 fig, 1 tab, 22 ref.

Descriptors: *Unsaturated flow, *Gravity flow, *Boulton's equation, *Mathematical studies, *Groundwater movement, Mathematical equations, Boussinesq equation.

Despite recent advances in numerical methodology, the solution of the complete equations describing saturated-unsaturated flow in an unconfined aquifer remains a difficult problem. For practical purposes both the linearized Boussinesq equation (LBE) and the Boulton integro-differential equation (BIE) can be useful in the simulation of certain aspects of gravity drainage problems (similar to those observed in sand tank experiments), provided that an estimation of the parameters is possible. The values of the parameters can be determined from available outflow data, by using the method of moments, or any other appropriate technique. These data may be obtained experimentally from field measurements. For large times the BIE provides only slightly better accuracy than the LBE. Both equations provide higher accuracy for large aquifers. However, the LBE is preferable by far because its adjusted parameters can be estimated rather easily. Comparison of exact solutions and analytical solutions obtained by means of the BIE indicates that no single set of the parameters eta and alpha predict both the outflow rates and drawdowns at various sections of the aquifer. It does not appear feasible now that a physical meaning can be assigned to each parameter. For the cases considered, the value of eta was slightly larger than unity which caused the BIE to behave in a way similar to the LBE at small times. Both equations produce outflow hydrographs with a characteristic t to the -1/2 power dependency for small times, which is much steeper than the more realistic solution of Richard's equation. For a small value of alpha, the BIE produces an inflection in the outflow hydrograph. This type of feature has never been observed in laboratory or field experiments. All this evidence suggests that the delayed yield formulation is neither practical nor suitable as an improvement of the free-surface approximation, to allow the inclusion of partly saturated flow effects in the description of gravity drainage problems. (Lantz-PTT)
W87-01584

HODOGRAPH TRANSFORMATION FOR FLOW THROUGH A DAM WITH SLOPING WALLS AND NO TAIL WATER,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 8B.
W87-01595

STEADY INFILTRATION FROM LARGE SHALLOW PONDS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
For primary bibliographic entry see Field 2A.
W87-01596

MODELING OF A LIQUID PHASE GEOTHERMAL DOUBLET SYSTEM AT REGINA, SASKATCHEWAN, CANADA,
Regina Univ. (Saskatchewan). Energy Research Unit.
For primary bibliographic entry see Field 4B.
W87-01597

GROUNDWATER FLOW IN LOW-PERMEABILITY ENVIRONMENTS,
Geological Survey, Reston, VA. Water Resources Div.
C. E. Neuzil.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1163-1195, August 1986. 7 fig, 1 tab, 385 ref.

Descriptors: *Literature review, *Groundwater movement, *Permeability, Hydraulic permeability, Geohydrology, Flow characteristics, Osmosis, Ultrafiltration, Flow pattern, Hydraulic head, Pore velocity.

Certain geologic media are known to have small permeability; subsurface environments composed of these media and lacking well developed secondary permeability have groundwater flow systems with many distinctive characteristics. Moreover, groundwater flow in these environments appears to influence the evolution of certain hydrologic, geologic, and geochemical systems, may affect the accumulation of petroleum and ores, and probably has a role in the structural evolution of parts of the crust. Such environments are also important in the context of waste disposal. This review attempts to synthesize the diverse contributions of various disciplines to the problem of flow in low-permeability environments. The first part of the review considers experimental investigations of low-permeability flow, including in situ testing; these are generally conducted on temporal and spatial scales which are relatively small compared with those of interest. Results from this work have provided increasingly detailed information about many aspects of the flow but leave certain questions unanswered. Two important nonhydraulic flow phenomena, osmosis and ultrafiltration, are experimentally well established in prepared clays but have been incompletely investigated, particularly in undisturbed geologic media. Small-scale experimental results form much of the basis for analyses of flow in low-permeability environments which occurs on scales of time and size too large to permit direct observation. One-dimensional studies have begun to elucidate how simple burial or exhumation can generate transient flow conditions by changing the state of stress and temperature and by burial metemorphism. Investigation of the more complex problem of the interaction of geologic processes and flow in two and three dimensions is just beginning. The difficulties associated with analysis are matched by those of characterizing hydrologic conditions in tight environments; measurements of hydraulic head and sampling of pore fluids have been done only rarely because of the practical difficulties involved. (Lantz-PTT)
W87-01620

SIMULATION OF MICROBIAL GROWTH DYNAMICS COUPLED TO NUTRIENT AND OXYGEN TRANSPORT IN POROUS MEDIA,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-01622

BEHAVIOR OF GROUNDWATER IN THE VICINITY OF THE WATER TABLE EVIDENCED BY SPECIFIC DISCHARGE PROFILES,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
D. Ronen, M. Magaritz, N. Paldor, and Y. Bachmat.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1217-1224, August 1986. 9 fig, 4 tab, 23 ref.

Descriptors: *Groundwater movement, *Water table, *Specific discharge, Flow profiles, Aquifers, Mathematical models, Radioactive tracers, Hydraulic conductivity, Capillary water.

Detailed vertical profiles of the horizontal component of the specific discharge, at the water table region of a phreatic aquifer, were obtained from two research wells, employing both a modified point dilution technique under natural flow conditions and a mathematical diffusion model. H2(18)O-depleted water was used as a tracer. A 2.5-m multilayer sampler with dialysis cells at 3-cm intervals was utilized both to introduce the tracer into groundwater, and determine its temporal variations. Large variations in the profiles of the tracer concentration were observed in a relatively thin layer just below the water table. The horizontal specific discharge increased with depth from 0.5 m/yr in the first 50 cm below the water table to 4.5 m/yr at 240 cm depth. Two theories are suggested to explain the presence of an almost stagnant zone at the water table region: (1) the existence of entrapped-migrating air bubbles which reduce the hydraulic conductivity and (2) drag forces exerted by the capillary fringe. (Author's abstract)
W87-01623

EXACT SOLUTION FOR THE PROBLEM OF CROSSFLOW IN A BOUNDED TWO-AQUIFER SYSTEM WITH AN AQUITARD,
Scientific Research Inst. of Petroleum Exploration and Development, Beijing (China).
Z. Chen, Z. Pang, L. Jiang, and M. Liu.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1225-1236, August 1986. 9 fig, 4 ref, 4 append.

Descriptors: *Groundwater movement, *Subsidence, *Aquifer systems, *Crossflow, *Aquitards, *Mathematical analysis, Mathematical equations, Flow pattern, Hydraulic head, Homogeneity, Hydrologic systems, Mathematical studies.

The theory of crossflow in a multilayered system plays an important role in hydrology because it provides a theoretical foundation for evaluating groundwater resources. Methods and procedures were used to solve the problem of flow in a bounded aquifer system without any restriction on the flow in the aquitard. A solution has been found for the general case from which one can evaluate the behavior of the whole system. The total rate of crossflow as well as the average value for land subsidence has been obtained using the method of mean value. In the typical case of a homogeneous circular reservoir with only one well at the center, an exact solution has been developed. Numerical evaluations have been carried out so that problems of crossflow and interference between layers can be treated. Furthermore, since the variation of hydraulic head versus space and time has been given, one may predict not only the average amount of land subsidence but also the more interesting feature of the resulting surface slope due to subsidence. These results provide a theoretical and practical basis for evaluating groundwater resources and problems of oil production and the effects of water injection in multilayered reservoirs. They can also be used in solving problems of land subsidence. (Lantz-PTT)
W87-01624

INTEGRAL SOLUTION FOR THE DIFFUSION-ADVECTION EQUATION,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-01625

SLUG TEST ANALYSIS,
Stanford Univ., CA. School of Earth Sciences.
A. Sageev.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1323-1333, August 1986. 19 fig, 3 tab, 23 ref. DOE Contract DE-AT02-80SF11459.

Descriptors: *Aquifers, *Slug tests, *Data interpretation, *Mathematical analysis, Hydraulic head, Mathematical studies, Hydraulic properties, Groundwater movement, Groundwater storage.

The pressure or head response of an aquifer to a slug test in a fully penetrating well with wellbore storage and skin is presented. Three kinds of type curves are discussed: early time log-log, intermediate time semilog, and late time log-log. The early time response of the slug test depends on the presence of wellbore skin; hence two kinds of early time type curves are presented. When the active well has wellbore skin, the early time correlating parameter is the product of the skin and dimensionless storage. When wellbore skin is not present, the early time response is proportional to the square root of time, with dimensionless storage as the correlating parameter. The intermediate time semilog type curves are applicable when wellbore skin is not present. The late time type curves may by used when the dimensionless storage is greater than one and wellbore skin is positive or when the dimensionless storage is smaller than one and wellbore skin is negligible. The radius of investigation of the slug test is also examined with and without wellbore skin at the active well. Although the presence of wellbore skin reduces the magnitude of the dimensionless head responses at observation wells, the detectable radius of investigation is not significantly dependent on wellbore skin. (Author's abstract)
W87-01634

EFFECTS OF HETEROGENEOUS ADSORPTION BEHAVIOR ON ION TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5B.
W87-01635

NWWA CONFERENCE ON SURFACE AND BOREHOLE GEOPHYSICAL METHODS IN GROUND WATER INVESTIGATIONS.
National Water Well Association, Worthington, OH.
Available from the National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, OH. $35.00. February 12-14, 1985, Fort Worth, Texas. 1985. 424 p.

Descriptors: *Borehole geophysics, *Surface-groundwater relations, *Groundwater, Groundwater availability, Groundwater potential, Electrical studies, Gravity studies, Groundwater pollution, Groundwater quality, Geophysics.

Government officials, consulting engineers, hydrogeologists, geophysicists, and geologists, researchers, industry representatives and other interested persons met to learn and discuss state-of-the-art techniques employed in performing groundwater investigations, using both surface and borehole geophysical methods. Additionally, the latest in state-of-the-art instrumentation and equipment was discussed and displayed. The conference provided a forum for all who attended to communicate and share their experiences in the rapidly developing field of hydrogeophysics. Subjects covered during this meeting included: surface electrical methods in groundwater exploration; gravimetric and seismic methods in groundwater exploration; integrated programs for groundwater quality investigations; magnetic methods to delineate zones of contamination, borehole geophysical methods for identifying aquifer characteristics, and borehole geophysical methods for characterizing hazardous waste sites and contaminant plumes. These proceedings are a compilation of papers presented by the symposium speakers. (See also W87-01642 thru W87-01668) (Lantz-PTT)
W87-01641

GEOELECTRIC DELINEATION OF A COASTAL RIDGE AQUIFER,
University of South Florida, Tampa. Dept. of Geology.
M. Stewart, A. Stodghill, and P. Putzier.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 1-11, 6 fig, 4 ref.

Descriptors: *Coastal aquifers, *Resistivity surveys, *Groundwater availability, *Geoelectricity, *Stratigraphy, *Electrical studies, Martin County, St. Lucie County, Florida, Stratification, Resistivity, Geohydrology, Carbonates, Groundwater, Aquifers.

Surface DC resistivity surveys were used to delineate stratigraphic zones of the Coastal Ridge Aquifer in Martin and St. Lucie Counties, southeast-Florida. Data from one hundred and forty-one vertical electrical soundings (VES) indicate four distinct geoelectric layers within the region: 1) a shallow, high resistivity zone, 1 to 3 m thick at or near the surface; 2) a shallow, low resistivity zone, 2 to 12 m thick, below layer one; 3) a deep, high resistivity target zone, approximately 20 m thick, below layer two; and 4) a deep, low resistivity layer immediately below the target zone which extends below the survey exploration depth and forms the bottom boundary of the aquifer. The siliceous and carbonate clastic sediments of the aquifer are Pliocene-Pleistocene in age. Integration of the geoelectric data with lithologic information shows the deep, high resistivity target zone to be composed of two lithologies; a well-cemented, porous calcarenite, and coarse shell and sand beds. The sediments within the Coastal Ridge Aquifer, have the highest potential for groundwater development. Their extent and estimated relative yield can be mapped from the VES data. The boundaries of the major hydrogeologic zones defined by the DC data agree very closely with boundaries determined by pumping tests in adjacent Indian River County. This application of DC resistivity is not limited to southeast Florida. Regions that have 1) layered, relatively horizontal strata, 2) good lithologic control, and 3) fairly constant water quality of low ionic strength, should produce geoelectric results that can be interpreted in terms of hydrostratigraphy. In particular, this survey of the Coastal Ridge Aquifer provides a depositional model for investigations in other coastal regions. (See also W87-01641) (Lantz-PTT)
W87-01642

AUTOMATED D.C. RESISTIVITY SYSTEM,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
R. W. Taylor.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 12-22, 8 fig, 3 ref.

Descriptors: *Resistivity, *Groundwater availability, *Geoelectricity, Self-potential, Polarization, Aquifers, Field studies, Data acquisition, Groundwater, Electrical studies, Geophysical surveys.

To increase the utility of electrical measurements in groundwater studies, an automated resistivity system was constructed. In operation, the system uses a two man crew to simultaneously acquire resistivity, self-potential and induced polarization measurements at almost any number of electrode spacings. These measurements are acquired, processed and stored by a microcomputer which also acquires and stores geographic location. During an 8-hr field deployment, the system occupied 192 stations within 4 acres, and acquired a combined total of approximately 10,000 individual measurements of resistivity, self potential and induced polarization. (See also W87-01641) (Author's abstract)
W87-01643

SELECTION OF PROPER SURFACE RESISTIVITY TECHNIQUES AND EQUIPMENT FOR EVALUATION OF GROUNDWATER CONTAMINATION,
JRB Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5B.
W87-01644

APPLICATION OF AN AUTOMATIC EARTH RESISTIVITY SYSTEM FOR DETECTING GROUND WATER MIGRATION UNDER A MUNICIPAL LANDFILL,
Southwest Research Inst., San Antonio, TX.
For primary bibliographic entry see Field 7B.
W87-01645

TERRAIN CONDUCTIVITY AS A TOOL FOR DELINEATING HYDROCARBON PLUMES IN A SHALLOW AQUIFER - A CASE STUDY,
Woodward-Clyde Consultants, Houston, TX.
For primary bibliographic entry see Field 7B.
W87-01646

GEOPHYSICAL MONITORING OF AN INJECTED CONTAMINANT PLUME: EXPERIMENTS WITH A DISPOSABLE E-LOG,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W87-01647

APPLICATIONS OF MICROGRAVITY SURVEYS TO SUBSURFACE EXPLORATION,
STS Consultants Ltd., Lansing, MI.
For primary bibliographic entry see Field 7B.
W87-01648

GRAVITY AND SEISMIC REFRACTION MEASUREMENTS FOR DEEP GROUND WATER SEARCH IN SOUTHERN DARFUR REGION, SUDAN,
Kuwait Univ., Safat. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W87-01649

SHALLOW SEISMIC REFLECTION METHOD FOR USE IN MAPPING OVERBURDEN STRATIGRAPHY,
Geological Survey of Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W87-01650

SEISMIC REFLECTION PROFILING IN THE CEDAR RIVER BASIN, WESTERN WASHINGTON,
Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W87-01651

MONITORING OF SUBSURFACE CONTAMINANTS WITH BOREHOLE/SURFACE RESISTIVITY MEASUREMENTS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 7B.
W87-01652

ROLE OF GEOLOGICAL AND GEOPHYSICAL DATA IN MODELING AN ALLUVIAL BASIN, SOUTHWEST NEW MEXICO,
Harding-Lawson Associates, Novato, CA.
For primary bibliographic entry see Field 7B.
W87-01654

COMPARATIVE ANALYSIS OF SURFACE RESISTIVITY SURVEYS AND NATURAL-GAMMA RADIATION BOREHOLE LOGS IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W87-01655

MILITARY REQUIREMENTS FOR GEOPHYSICAL GROUND WATER DETECTION AND EXPLORATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 7B.
W87-01656

USE OF GEOPHYSICAL TECHNIQUES IN AN ACCELERATED SEARCH FOR GROUND WATER IN THE CONNECTICUT RIVER VALLEY, MASSACHUSETTS,
Boston Survey Consultants, Inc., MA.
For primary bibliographic entry see Field 7B.
W87-01657

MAGNETIC SURVEY METHODS USED IN THE LUITIAL ASSESSMENT OF A WASTE DISPOSAL SITE,
BCM Engineers, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5B.
W87-01658

APPLICATION OF THE CONTROLLED SOURCE AUDIO MAGNETOTELLURICS (CSAMT) SURVEY TO DELINEATE ZONES OF GROUND WATER CONTAMINATION - A CASE HISTORY,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 7B.
W87-01659

STRATEGY FOR THE HYDROLOGIC INTERPRETATION OF WELL LOGS,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 7C.
W87-01660

STRATIGRAPHIC DETERMINATIONS AND CORRELATIONS BASED ON BOREHOLE GEOPHYSICS,
Florida Geological Survey, Tallahassee.
For primary bibliographic entry see Field 7C.
W87-01661

THEORY & DESIGN CONSIDERATIONS OF A BOREHOLE ELECTROMAGNETIC CONDUCTIVITY PROBE,
Geonics Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 7B.
W87-01662

DEFINING GLACIAL STRATIGRAPHY WITH THE NEUTRON LOG,
STS Consultants Ltd., Green Bay, WI.
For primary bibliographic entry see Field 7B.
W87-01663

DRY HOLE RESISTIVITY LOGGING,
Converse Consultants, Inc., Las Vegas, NV.
For primary bibliographic entry see Field 7B.
W87-01664

USE OF DOWNHOLE GEOPHYSICAL METHODS IN DETERMINING THE INTERNAL STRUCTURE OF A LARGE LANDFILL,
Warzyn Engineering, Inc., Madison, WI.
For primary bibliographic entry see Field 7B.
W87-01665

BOREHOLE LOGGING TO DELINEATE FRACTURES IN A CONTAMINATED BEDROCK AQUIFER,
NUS Corp., Bedford, MA.
For primary bibliographic entry see Field 7B.
W87-01666

CONVECTION IN BOREHOLES: LIMITS ON INTERPRETATION OF TEMPERATURE LOGS AND METHODS FOR DETERMINING ANOMALOUS FLUID-FLOW,
Geological Survey, Denver, CO.
T. C. Urban, and W. H. Diment.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 399-413, 7 fig, 1 tab, 21 ref.

Descriptors: *Convection, *Borehole geophysics, *Logging, *Temperature, *Data interpretation, *Flow pattern, Data acquisition, Flow profile, Geothermal studies, Mono County, Imperial County, California, Temperature control, Temperature gradient.

The effects of convection on conventional temperature logs, which are obtained by lowering a temperature sensor down a hole at a fixed rate, are significant. Thus, there is a limit to which this method can be utilized to resolve such problems as the details of the variation of thermal conductivity of the rocks surrounding the hole or small flows of water or gas into or out of the hole. For the analysis of continuous temperature logs, the authors have developed a simple technique for determining the variation of the aspect ratio (A) with depth. If A is too large, or small, or excessively erratic over a significant length of a hole, something anomalous is expected: faulty instrumentation; fluid or gas flow into or out of the hole; exsolution of gas generated by chemical reactions within the casing; fluid motion in the annulus between the casing and the hole, or the presence of dilute mud in the hole. Results from two boreholes in different hydrologic settings are used as examples: Mammoth No. 1, Mono County, California (a deep high-temperature geothermal well containing a small diameter tubing) and Bonds Corner No. 1, Imperial County, California (a cased well that is partially filled with dilute mud that penetrates a sand-shale sequence of highly variable thermal conductivity). The development of precision, digitally recorded temperature logs, along with a modest computer capability, permits manipulation of subsurface temperature data that was impossible a few years ago. Although the increased capability illustrates the imperfection in data acquisition systems, field techniques, and lack of theoretical and experimental knowledge of convection in drill holes, it may also open promising avenues for expanded use of temperature logging. (See also W87-01641) (Lantz-PTT)
W87-01667

RESISTIVITY-POROSITY CROSS PLOTS FOR DETERMINING IN SITU FORMATION WATER QUALITY - CASE EXAMPLES,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 7B.
W87-01668

FOURTH NATIONAL SYMPOSIUM AND EXPOSITION ON AQUIFER RESTORATION AND GROUND WATER MONITORING.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5G.
W87-01669

DESIGN AND EVALUATION OF IN-PLACE CONTAINMENT STRUCTURES UTILIZING GROUND WATER CUTOFF WALLS,
For primary bibliographic entry see Field 5G.
W87-01670

DESIGN OF SOIL-BENTONITE BACKFILL MIX FOR THE FIRST ENVIRONMENTAL PROTECTION AGENCY SUPERFUND CUTOFF WALL,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
For primary bibliographic entry see Field 5G.
W87-01671

HYDROGEOLOGIC ASPECTS OF SLURRY WALL ISOLATION SYSTEMS IN AREAS OF HIGH DOWNWARD GRADIENTS,
For primary bibliographic entry see Field 5G.
W87-01672

SLURRY WALL INSTALLATION BY THE VIBRATED BEAM TECHNIQUE,
For primary bibliographic entry see Field 8A.
W87-01673

OPTIMIZING PUMPING STRATEGIES FOR CONTAMINANT STUDIES AND REMEDIAL ACTIONS,
Robert S. Kerr Environmental Research Lab., Ada, OK. Ground Water Research Branch.
For primary bibliographic entry see Field 5G.
W87-01674

HYDRODYNAMIC ISOLATION IN HAZARDOUS WASTE CONTAINMENT,
For primary bibliographic entry see Field 5G.
W87-01675

DETERMINING OPTIMUM PUMPING RATES FOR CREATION OF HYDRAULIC BARRIERS TO GROUND WATER POLLUTANT MIGRATION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W87-01676

DOUBLE-CELL HYDRAULIC CONTAINMENT OF POLLUTANT PLUMES,
For primary bibliographic entry see Field 5G.
W87-01677

PRACTICAL ASPECTS OF THE DESIGN, INSTALLATION AND OPERATION OF GROUND WATER EXTRACTION SYSTEMS,
Harding-Lawson Associates, Novato, CA.
A. M. Burow.

IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 71-74, 2 tab, 1 ref.

Descriptors: *Design standards, *Installation, *Extraction systems, *Water pollution treatment, *Groundwater pollution, Plumes, Cleanup, Cost-benefit analysis, Unconfined aquifers, Leakage, Slope, Recharge, Aquifers.

Control and cleanup of contaminant plumes in aquifers is usually accomplished with extraction well systems. A typical sequence of events for cleaning up an aquifer once the presence of contamination is known is: contaminant plume characterization, hydrogeologic characterization, formulation of cleanup objectives, extraction system design, regulatory approval, extraction system installation and system monitoring to verify performance. During this process, trade-offs continually develop between the costs and the benefits associated with obtaining necessary information and coordinating the necessary analysis. This paper outlines the steps necessary to design an extraction system and discusses some of the problems often encountered in the process, such as: (1) unconfined aquifers, (2) the presence of non-constant gradients, (3) vertical leakage, and (4) aquifer interconnection, and regional recharge and discharge effects. (See also W87-01669) (Lantz-PTT)
W87-01678

ASSESSMENT OF PURGE WELL EFFECTIVENESS FOR AQUIFER DECONTAMINATION,
Geologic Testing Consultants Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5G.
W87-01679

SUBSURFACE ORGANIC RECOVERY AND CONTAMINANT MIGRATION SIMULATION,
For primary bibliographic entry see Field 5G.
W87-01680

REMOVAL OF VINYLIDENE CHLORIDE FROM GROUND WATER BY AIR STRIPPING AND ACTIVATED CARBON ADSORPTION,
For primary bibliographic entry see Field 5G.
W87-01681

AIR STRIPPING FOR VOCS IN WATER: PILOT-DESIGN-CONSTRUCTION,
For primary bibliographic entry see Field 5G.
W87-01682

BIOLOGICAL TREATMENT OF ETHYLENE GLYCOL-CONTAMINATED GROUND WATER AT NAVAL AIR ENGINEERING CENTER LAKEHURST, NEW JERSEY,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-01683

BIOLOGICAL TREATMENT OF A BRINE GROUND WATER CONTAMINATED WITH HIGH CONCENTRATIONS OF ORGANICS,
DETOX, Inc., Dayton, OH.
For primary bibliographic entry see Field 5G.
W87-01684

EVALUATION OF A PROPOSED SYNTHETIC CAP AND CONCRETE CUTOFF WALL AT LOVE CANAL USING A CROSS-SECTIONAL MODEL,
GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 5G.
W87-01685

TRANSPORT MODELING IN THE RESTORATION OF STRATIFIED AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-01686

MODEL STUDY OF SELECTED MITIGATIVE STRATEGIES TO CONTROL RADIONUCLIDE MIGRATION IN GROUND WATER,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W87-01687

REMEDIAL ACTION EVALUATION WITH SIMPLIFIED METHODS,
Anderson-Nichols and Co., Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5G.
W87-01688

INTERIM STATUS GROUND WATER MONITORING SYSTEM ASSESSMENTS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 7A.
W87-01689

GROUND WATER MONITORING SYSTEM DESIGN IN A COMPLEX GEOLOGIC SETTING,
Conversion Systems, Horsham, PA.
For primary bibliographic entry see Field 7A.
W87-01690

USE OF COMPUTER MODELING TECHNIQUES IN THE DESIGN OF A MONITORING PROGRAM AT A HAZARDOUS WASTE SITE,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5G.
W87-01691

SAMPLING GROUND WATER FOR VOLATILE ORGANIC COMPOUNDS: THE EFFECTS OF SAMPLING METHOD, COMPOUND VOLATILITY AND CONCENTRATION,
For primary bibliographic entry see Field 5A.
W87-01693

PRESERVING THE CHEMICAL INTEGRITY OF A GROUND WATER SAMPLE,
Residuals Management Technology, Inc., Madison, WI.
For primary bibliographic entry see Field 5A.
W87-01694

BACKGROUND GROUND WATER QUALITY MONITORING: TEMPORAL VARIATION,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5G.
W87-01695

REMOTE ANALYSIS OF GROUND WATER CONTAMINANTS USING LASER FLUORESCENCE,
Tufts Univ., Medford, MA. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5A.
W87-01696

STRADDLE PACKER SAMPLING AND TESTING OF WELLS COMPLETED IN TRIASSIC ROCKS OF PENNSYLVANIA,
Ground Water Associates, Inc., Arlington, MA.
For primary bibliographic entry see Field 5A.
W87-01697

SAMPLING PROCEDURES FOR THE BISCAYNE AQUIFER PROTECTION STUDY,
For primary bibliographic entry see Field 5A.
W87-01698

GROUND WATER MONITORING: A PRACTICAL APPROACH FOR MAJOR UTILITIES,
For primary bibliographic entry see Field 5B.
W87-01699

CONVERSION OF RESOURCE EXPLORATION HOLES TO MONITORING WELLS,
Bechtel Energy Corp., Memphis, TN.
For primary bibliographic entry see Field 7A.
W87-01700

DRILLING CONTAINMENT SYSTEM FOR HAZARDOUS WASTE SITE INVESTIGATIONS,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-01701

EVALUATION OF GROUND WATER CONTAMINATION BY DISSOLVED HYDROCARBONS IN A VARIETY OF HYDROGEOLOGIC SETTINGS,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
For primary bibliographic entry see Field 5B.
W87-01702

DETERMINATION OF HYDROCARBON THICKNESSES IN SEDIMENTS USING BOREHOLE DATA,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 5B.
W87-01703

MONITORING PETROLEUM SPILLS WITH WELLS: SOME PROBLEMS AND SOLUTIONS,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 5B.
W87-01704

DISCRIMINATION BETWEEN REAL AND APPARENT ACCUMULATION OF IMMISCIBLE HYDROCARBONS ON THE WATER TABLE: A THEORETICAL AND EMPIRICAL ANALYSIS,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
For primary bibliographic entry see Field 5B.
W87-01705

PETROLEUM PRODUCT RECOVERY IN COASTAL FACILITIES UTILIZING TIDAL FLUCTUATIONS,
Haley and Aldrich, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5B.
W87-01707

GROUND WATER DECONTAMINATION TECHNIQUES FOR REMOVAL OF FREE FLOATING AND DISSOLVED HYDROCARBONS FROM A WATER TABLE AQUIFER OVERLYING THE FLORIDAN AQUIFER IN SOUTHWEST FLORIDA,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
For primary bibliographic entry see Field 5D.
W87-01708

HYDROGEOLOGIC SITE ASSESSMENT VS. REALITY AT A CHEMICAL PLANT,
Roux Associates, Inc., Halesite, NY.
For primary bibliographic entry see Field 5B.
W87-01710

FIELD MONITORING OF THE ADAMS, MASSACHUSETTS LANDFILL LEACHATE PLUME,
For primary bibliographic entry see Field 5B.
W87-01711

MONITORING NETWORKS AND HYDROLOGIC BUDGET FOR EVALUATING A LEACHATE CONTROL SYSTEM IN A LANDFILL IN CALIFORNIA,
California State Univ., Fullerton. Dept. of Geology.
For primary bibliographic entry see Field 5B.

W87-01712

ORGANIC CONTAMINANT CONTROL IN A GULF COAST AQUIFER,
For primary bibliographic entry see Field 5G.
W87-01713

GROUND WATER RESTORATION PROJECTS: FIVE CASE HISTORIES,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-01715

IMPACT AND RECOVERY OF CHROMIUM WASTE LEAKED BENEATH AN INDUSTRIAL PLANT,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5G.
W87-01716

2G. Water In Soils

HILLSLOPE HYDROCHEMISTRY AND STREAM RESPONSE ON A WOODED, PERMEABLE BEDROCK: THE ROLE OF STEMFLOW,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. W. Crabtree, and S. T. Trudgill.
Journal of Hydrology, JHYDA7, Vol. 80, No. 1/2, p 161-178, September 15, 1985. 8 fig, 6 tab, 26 ref.

Descriptors: *Slopes, *Chemical properties, *Streams, *Bedrock, *Stemflow, *Hydrology, Storm runoff, Solutes, Rainfall, Soil chemistry, Percolation, Carbonate rocks.

The hillslope hydrochemical processes operating on a permeable carbonate bedrock can be linked to the hydrochemical response of a slop-foot stream to rainfall events. Solute sources, hydrochemical inputs and outputs, and storm responses have been evaluated for a wooded hillslope section. The data could not be interpreted in terms of a throughflow soil-water movement mechanism. Storm events produced a rapid input of solute-rich water movement stream by vertical percolation in the bedrock and subsequent lateral movement at depth; the solute-rich nature of the response implies that a displacement mechanism operates. The rapid response from the hillslope may be initiated by stemflow which produces large concentrated point-source inputs to the soil, by-passing the soil matrix. Baseflow runoff is produced by throughfall percolating through the soil matrix. Stemflow may explain the different hydrochemical responses of the wooded hillslope and the non-wooded upper portion of the catchment. (Author's abstract)
W87-01169

RELATIONSHIP BETWEEN THE RUNOFF CURVE NUMBER AND HYDROLOGIC SOIL PROPERTIES,
Southern Illinois Univ. at Carbondale. Dept. of Plant and Soil Sciences.
S.-K. Chong, and T.-M. Teng.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 1-7, April 15, 1986. 1 fig, 2 tab, 18 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff curve number, *Soil properties, *Infiltration, Hydrology, Soil water, Simulated rainfall.

The maximum soil water retention, saturated infiltration rate, and sorptivity were collected simultaneously from simulated rainfall experiments on Molokai soils. The maximum soil water retention and saturated infiltration rate were highly related. Addition of sorptivity in the regression analysis improved the coefficient of determination and the standard error of estimate. The saturated infiltration rate was much more important than sorptivity in predicting maximum soil water retention. The equation obtained in this study applied to other soils favorably predicted the runoff curve number of other soils. (Cassar-PTT)
W87-01261

STUDY OF VERTICAL WATER TRANSPORT IN SOIL BY NATURALLY ABUNDANT ISOTOPE TRACING, (ETUDE DE TRANSFERT VERTICAL DE L'EAU DANS UN SOL PAR TRACAGE ISOTOPIQUE EN ABONDANCE NATURELLE),
Centre de Recherches de Rennes (France). Lab. de Science du Sol.
P. Merot.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 300, No. 20, p 1033-1038, May 30, 1985. 5 fig, 8 ref.

Descriptors: *Mathematical models, *Soil water movement, *Water transport, *Isotopic tracers, *Oxygen isotopes, Brittany, Vertical flow, Soil physics, Evaporation.

Water transport in natural conditions on a brown leached soil was studied during winter and spring using naturally abundant 18-0. A tank model is proposed, based on the physical characterization of the soil. The model yields an average effective speed of 8 times 10 to the minus 7th power meters per sec. The model requires modification when applied in the spring due to the higher rate of evaporation then prevailing. The methodology may find application in other problems: the relationship between water transport and soil organization; the heterogeneity of water transport; the relationship between the dynamics of water and its geochemistry. (Airone-PTT)
W87-01344

CHARACTERIZATION OF THE DISPERSIVE PROPERTIES OF A POROUS MEDIUM BY EXPERIMENTAL MEASUREMENTS OF THE MIGRATION OF A SALINE TRACER, (CARACTERISATION DES PROPRIETES DISPERSIVES D'UN MILIEU POREUX PAR MESURES EXPERIMENTALES DE LA MIGRATION D'UN TRACEUR SALIN),
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 5B.
W87-01347

CALIBRATION OF A DUAL-ENERGY GAMMA RADIATION SYSTEM FOR MULTIPLE POINT MEASUREMENTS IN A SOIL,
Alabama Agricultural Experiment Station, Auburn.
J. W. Hopmans, and J. H. Dane.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1109-1114, July 1986. 4 fig, 3 tab, 9 ref.

Descriptors: *Calibrations, *Soil moisture meters, *Gamma radiation, *Mathematical studies, *Soil water, Soil columns, Cesium radioisotopes, Americium radioisotopes, Density.

The calibration constants for gamma-ray attentuation were determined experimentally at multiple measurement points along a soil column as needed to determine volumetric water content and dry bulk density simultaneously at each of these points during subsequent experiments. Calibration constants for the soil solids, for both 137-Cs and 241-Am, are defined as the product of the respective mass attenuation coefficients and the thickness of the soil through which the gamma radiation beam traverses. Calibration constants for water are similarly defined but include the additional term of water density. The calibration technique corrects for low energy 137-Cs pulses present in the 241-Am window and for resolving time. Although calibration constants are determined for each measurement point, the technique requires knowledge only of the initial average dry bulk density in the soil column and not at every point. The calibration constants and initial dry bulk density value for each measurement point are determined by an iteration procedure. Errors stemming from changes in the sources-soil column-detector configuration and/or pathlength when measuring at different points are therefore negated. (Author's abstract)
W87-01451

ECOLOGICAL INTERACTIONS BETWEEN THE ALLUVIAL FORESTS AND HYDROLOGY OF THE UPPER RHONE,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2I.
W87-01479

ASYMPTOTIC BEHAVIOR OF INFILTRATION IN SOILS CONTAINING CRACKS OR HOLES,
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Lucas Heights Research Labs.
M. R. Davidson.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1345-1353, September 1985. 6 fig, 2 tab, 12 ref.

Descriptors: *Soil water movement, *Infiltration, *Soils, *Cracks, *Model studies, *Infiltration rate, Soil water, Prediction.

An asymptotic, one-dimensional Green-Ampt model of infiltration into a soil containing regularly spaced vertical cracks, or a cylindrical soil column containing a central hole, is derived from a complete two-dimensional or axisymmetric Green-Ampt analysis by summing an asymptotic expansion for the infiltration rate valid at large times when the wetting front has become horizontal. This model is shown to be accurate at intermediate times when the front is not necessarily horizontal and corresponds to one-dimensional infiltration initiated from a plane lying below the soil surface at a depth which depends only on the geometry and which lies between zero and the crack (hole) depth. When applicable, model predictions of infiltration rate and cumulative infiltration obtained for cylindrical holes, like those previously obtained for cracks, agreed well with corresponding results based on finite difference solutions of the saturated-unsaturated flow equations. Differences were in the range of 2-9%. (Author's abstract)
W87-01528

TWO-PHASE NUMERICAL MODEL FOR PREDICTION OF INFILTRATION: CASE OF AN IMPERVIOUS BOTTOM,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, and J. A. Billica.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1389-1396, September 1985. 13 fig, 4 ref. NSF Grant CEE-8212668; USDA Research Agreement 58-9AHZ-3-39.

Descriptors: *Soil water movement, *Numerical analysis, *Model studies, *Prediction, *Infiltration, *Impervious boundaries, Soil water, Flow discharge, Computer programs, Infiltration rate, Moisture profiles, Profiles, Soil columns.

A numerical procedure is presented to describe soil moisture evolution in a column with an impervious bottom for varied boundary conditions at the soil surface. The procedure accounts for viscous resistance to simultaneous flow of water and air and for air compression. The method was programmed for the computer. In one case study, a 10-cm-deep soil column was subjected to a steady rainfall at the surface. Moisture profiles and infiltration rates were calculated by both the one- and two-phase approaches. Comparison demonstrates the magnitude of the error incurred when air effects are not incorporated in the analysis. In a second case study, a 100-cm-deep soil column was subjected to a sequence of two different rainfall rates. Again, comparison provides a measure of the error resulting from the neglect of air effects in the analysis. Not only is capacity infiltration rate greatly reduced after ponding of soil surface, but the ponding times themselves are greatly reduced due to increased viscous resistance to flow when airflow is considered in the analysis. The more rigorous analysis adds little to the complexity and cost of the calculations. (Author's abstract)
W87-01533

BUFFER CAPACITY OF FOREST SOILS IN NEW ENGLAND,

Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 5B.
W87-01565

ECOLOGICAL DIFFERENCES IN THE DEVELOPMENT OF THREE BIOGEOCENOSES IN THE TIGROVAYA BALKA RESERVE,
Akademiya Nauk Tadzhikskoi SSR, Dushanbe.
For primary bibliographic entry see Field 2I.
W87-01579

DISJUNCTIVE KRIGING 3. COKRIGING,
Robert S. Kerr Environmental Research Lab., Ada, OK.
S. R. Yates.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1371-1376, September 1986. 6 fig, 1 tab, 15 ref.

Descriptors: *Statistical methods, *Disjunctive kriging, *Kriging, *Cokriging, Mathematical equations, Mathematical studies, Soil water, Soil temperature, Statistical analysis.

The disjunctive kriging (DK) method is extended to account for more than one random function. Two random functions are considered, but this is easily generalized to any number. An example is presented using disjunctive cokriging (DCK) where the surface gravimetric moisture content is estimated using the bare soil temperature as an auxiliary random function. The results indicate that the DCK procedure produces a better estimator than ordinary cokriging in terms of reduced variance of errors and exactness of estimation. Also, using DCK, an estimate of the conditional probability that the level of a property is greater than a known cutoff value can be obtained. In general, this conditional probability is better than the DK probability by virtue of the additional information contained in the second, auxiliary random function. (Author's abstract)
W87-01586

ACCOUNTING FOR SPATIALLY VARIABLE INFILTRATION IN BORDER IRRIGATION MODELS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W87-01627

MODELING THE EFFECTS OF ACID DEPOSITION: CONTROL OF LONG-TERM SULFATE DYNAMICS BY SOIL SULFATE ADSORPTION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-01630

EFFECTS OF HETEROGENEOUS ADSORPTION BEHAVIOR ON ION TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5B.
W87-01635

SIMULATION OF LEACHING OF A GYPSIFEROUS-SODIC DESERT SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1341-1349, August 1986. 8 fig, 7 tab, 19 ref.

Descriptors: *Simulation analysis, *Leaching, *Deserts, *Gypsum, *Soil water, Chlorine, Sulfates, Calcium, Sodium, Conductivity, Salinity, Cation exchange, Sensitivity analysis, Saline soils.

Leaching a gypsiferous-sodic soil under different soil conditions and water qualities was investigated using a transport model combined with a salinity model. Incorporating field-measured values of the soil hydraulic properties and the dispersivity coefficient, profiles of the soil solution concentration of Cl, SO4, Ca and Na, and soil solution electrical conductivity (EC) obtained under intermittent leaching were simulated for a set of representative cases typical to gypsiferous-sodic soils. For a given soil depth and amount of applied water, the simulated soil solution concentration of chloride was affected only by the initial soil salinity and the salinity of the applied water. Simulated soil solution concentrations of calcium, sodium, and sulfate were also affected by the initial soil exchangeable sodium percentage (ESP), initial gypsum content, and the cation exchange capacity (CEC) of the soil. Sensitivity analysis of the model results suggest that soil CEC, initial soil salinity and ESP, and gypsum content have a significant impact on the soil salinity profiles during leaching. Possible applications of the combined model results for salinity control were demonstrated. Expressing the soil system response in terms of the soil solution EC, rather than the specific ion concentrations, the combinations of water quantity and quality (salinity) which yield a given soil solution EC at a given soil depth for different initial conditions and soil CEC were calculated. For a given salinity of the applied water, the amount of water required to maintain a given EC at a given soil depth increased as the initial soil salinity, soil ESP, gypsum content, and CEC rose. The calculated isosoil salinity lines can be used for economic evaluation of the least cost combination of the applied water quantity and quality which will ensure that a critical salinity at a given soil depth is not exceeded. (Author's abstract)
W87-01636

2H. Lakes

RESERVOIR SITE PREPARATION: SUMMARY REPORT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects Lab.
D. Gunnison, J. M. Brannon, and R. L. Chen.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report E-86-4, March 1986. Final Report. 51 p, 7 fig, 44 ref, 1 append.

Descriptors: *Site selection, *Reservoir siting, Literature review, Soil stripping, Reservoir filling, Leaching, Water quality.

Summary results are presented of Environmental and Water Quality Operational Studies (EWQOS) Work Unit IIF, Reservoir Site Preparation. The results of EWQOS and non-EWQOS studies pertinent to reservoir site preparation and initial filling are given in a summary of the literature, including discussions of clearing, soil stripping, initial filling, and reservoir aging. The procedures developed at the US Army Engineer Waterways Experiment Station and the application of laboratory study results to changes expected in water quality as a consequence of impoundment are given, and representative data are used to illustrate important trends. Existing regulations and specifications on reservoir site preparation and legislative requirements are discussed in an appendix. (Lantz-PTT)
W87-00870

TRANSPORT MODELS FOR INLAND AND COASTAL WATERS.
International Association for Hydraulic Research, Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W87-00922

SPECTRA PRESERVATION CAPABILITIES OF GREAT LAKES TRANSPORT MODELS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-00928

DYNAMIC RESERVOIR SIMULATION MODEL - DYRESM: 5,
Western Australia Univ., Nedlands.
J. Imberger, and J. C. Patterson.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 310-361, 12 fig, 36 ref.

Descriptors: *Model studies, *Lakes, *Solute transport, *Prediction, Reservoirs, Accuracy, Mathematical models, Rivers, Water quality, DYRESM model, Numerical models, Salinity, Temperature, Wellington Reservoir, Stratification, Australia, Mixing.

DYRSEM, a one-dimensional numerical model, has been successfully used for the prediction of temperature and salinity in small to medium sized reservoirs and lakes. It has only one calibrated coefficient, which does not vary widely from one lake to the next. The model has been validated in terms of temperature and salinity variations in three major lakes and two lakes with only poor data. Validation of the algorithms MIXER and DIFUSE are underway in western Australia. DYRESM appears the faithfully reproduce even very severe changes in the reservoir structure caused by large saline inflows, active scouring, strong wind deepening, and winter convective cooling. (See also W87-00922) (Cassar-PTT)
W87-00930

APPROACHES TO REVEGETATE SHORELINES AT LAKE WALLULA ON THE COLUMBIA RIVER, WASHINGTON-OREGON,
Agricultural Research Service, Prosser, WA.
R. D. Comes, and T. McCreary.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA 166943, A05 in paper copy, A01 in microfiche. Technical Report E-86-2, January 1986. Final Report. 91 p, 27 fig, 21 tab, 4 ref, 1 append.

Descriptors: *Lakes, *Water quality control, *Revegetation, *Reservoirs, Columbia River, Vegetation, Shore protection, Shoreline cover, Lake Wallula, McNary Reservoir, Flooding, Willow, Dwarf spikerush, Sedges, Water level fluctuations, Bulrushes.

Plant species and revegetation techniques were studied for three years at Lake Wallula, Washington-Oregon (McNary Reservoir). Twenty-nine native and naturalized riparian species were subjected to inundation treatments to evaluate survival and growth responses in a subimpoundment with controlled water levels and on two shoreline sides (a mudflat and a sandy beach). In the controlled impoundment site, willows (Salix fragilis and Salix purpurea), dwarf spikerush (Eleocharis coloradoensis), and two sedges Carex obnupta and C. rostrata) were the most successful species. Inundation depth and duration were found to directly affect performance of the plant species. However, the effects of weather and wildlife confounded treatment effects on plant growth and survival at the shoreline sites. Here only softstem bulrush (Scirpus validus) survived all inundation treatments. (Cassar-PTT)
W87-00944

LINKED HYDRODYNAMIC AND BIOGEOCHEMICAL MODELS OF WATER QUALITY IN SHALLOW LAKES,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W87-00951

CURRENT STATUS OF WATER QUALITY IN LONG, JOHANNA AND JOSEPHINE LAKES - A SUMMARY REPORT ON THE DETAILED EVALUATION OF THE LONG LAKE CHAIN OF LAKES IMPROVEMENT PROJECT,
Environmental Research Group., Inc., St. Paul, MN.
For primary bibliographic entry see Field 5G.
W87-00955

CHARACTERISTICS OF BENCH-MARK STREAMS.
For primary bibliographic entry see Field 5B.
W87-00977

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOME LAKES IN NORTH AMERICA FOR WHICH SEDIMENT-DIATOM DATA EXIST.
For primary bibliographic entry see Field 5B.
W87-00978

ABUNDANCE, GROWTH AND FEEDING OF NATTERJACK TOADS (BUFO CALAMITA) IN A 4-YEAR-OLD ARTIFICIAL HABITAT,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
J. J. Boomsma, and J. W. Arntzen.
Journal of Applied Ecology JAPEAI, Vol. 22, No. 2, p 395-405, August 1985. 4 fig, 2 tab, 26 ref.

Descriptors: *Toads, *Aquatic haitats, *Feeding rates, *Artificial watercourses, *Animal growth, Amphibians, Wetlands, Animal populations, Population dynamics, Growth rates, Ecological distribution.

Population density, growth and feeding habits of pioneering natterjack toads were studied in an artifically raised wetland site near Amsterdam, the Netherlands. Cohorts of fast growing juvenile toads were added to the population in the third and fourth years after creation of the habitat, but other amphibians were absent after four years of succession. Subadult natterjacks matured early and dispersed well. Comparison of natterjack stomach contents with that of other invertebrates showed no qualitative food preference by the toads, thus indicating the possibility of a fast functional response to temporary but locally abundant prey. The study confirms that the natterjack is highly flexible and well adapted as a pioneer. (Author's abstract)
W87-01017

MORTALITY OF SMOLT OF ATLANTIC SALMON, SALMO SALAR L., AT LOW LEVELS OF ALUMINIUM IN ACIDIC SOFTWATER,
Direktoratet for Vilt og Ferskvannsfisk, Aas (Norway). Fish Research Div.
For primary bibliographic entry see Field 5C.
W87-01032

MICROPROFILES OF OXYGEN IN EPIPHYTE COMMUNITIES ON SUBMERGED MACROPHYTES,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
K. Sand-Jensen, N. P. Revsbech, and B. B. Jorgensen.
Marine Biology MBIOAJ, Vol. 89, No. 1, p 55-62, October 1985. 6 fig, 24 ref.

Descriptors: *Epiphytes, *Anoxic conditions, *Eutrophication, *Algae, *Oxygen, *Macrophytes, Light-dark cycles, Plant physiology, Molecular diffusion, Boundary layers, Carbon dioxide.

Microprofiles of oxygen were measured by 2- to 10-micron diameter electrodes within 0.2- to 2.0-mm thick epiphyte layers on different marine and freshwater macrophytes during artificial light-dark cycles. The epiphyte community created large fluctuations in oxygen concentrations at the macrophyte surface by increasing the thickness of the layer around the macrophytes in which the transport of solutes occurred by molecular diffusion and by contributing to the combined epiphyte-macrophyte activity. When epiphytes were removed, the diffusive boundary layer was reduced to 100 to 200 micron, and the oxygen fluctuations declined. Oxygen fluctuations varied depending on the species of macrophyte. Epiphyte communities attenuate light and increase the transfer resistance for fluxes of dissolved substances between the bulk phase and the plant surface. Dense epiphyte communities that develop in eutrophic waters may therefore be a severe stress to macrophyte metabolism by shading and by generating anoxic conditions at the macrophyte surface in the dark and high O2 and low CO2 concentrations in the light. (Rochester-PTT)
W87-01054

CARBON AND NITROGEN CONTENT OF NATURAL PLANKTONIC BACTERIA,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 5A.
W87-01077

USE OF METABOLIC INHIBITORS TO ESTIMATE PROTOZOOPLANKTON GRAZING AND BACTERIAL PRODUCTION IN A MONOMICTIC EUTROPHIC LAKE WITH AN ANAEROBIC HYPOLIMNION,
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-01078

BACTERIAL INHIBITORS IN LAKE WATER,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W87-01079

MICROOXIC-ANOXIC NICHE OF BEGGIATOA SPP.: MICROELECTRODE SURVEY OF MARINE AND FRESHWATER STRAINS,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-01080

ESTIMATES OF ANNUAL PRODUCTION FOR SOME AQUATIC INSECTS FROM THE LA TROBE RIVER, VICTORIA,
Museum of Victoria, Abbotsford (Australia).
R. Marchant.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 113-120, 1986. 2 tab, 20 ref.

Descriptors: *Aquatic insects, *Secondary productivity, *La Trobe River, Victoria, Australia, Ephemeroptera, Plecoptera, Trichoptera, Annual production, Temperature, Temperate zone, Tropic zone.

Annual production was estimated by the size-frequency method for Ephemeroptera (Tasmanocoenis tonnoiri, two species of Baetis, Atalonella spp., Atalophlebioides sp), Plecoptera (Leptoperla spp), and Trichoptera (Ecnomus sp) at four sites on the lowland section of the La Trobe River. Annual production (P) of individual ephemeropteran species (or genera) varied from 0.02 to 0.7 g/sq m whereas total annual production of this order at two sites (La Trobe River lowland, Australia) was 0.7-1.5 g/sq m. Annual production of Leptoperla spp was 0.03 g/sq m at one site whereas Ecnomus sp averaged 2 g/sq m at two sites. Estimates of annual production were subject to an error of at least + or - 50%. Annual turnover ratios (P/B, where B is mean biomass) varied from 9-19 and were 3-4 times higher than published values for similar-sized macroinvertebrates in the temperate zone (generally <15 C mean annual habitat temperature). This probably resulted from the higher average temperatures (17-18 C) at most sites. (Author's abstract)
W87-01081

DIETARY STUDIES OF AQUATIC INSECTS FROM TWO VICTORIAN RIVERS,
Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. C. Chessman.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 129-146, 1986. 6 tab, 28 ref.

Descriptors: *Diets, *Aquatic insects, *La Trobe River, *Tanjil River, Australia, Coleoptera, Diptera, Ephemeroptera, Plecoptera, Trichoptera, Detritus, Diatoms, Bacteria, Fungi, Algae, Shredders, Diversity.

A preliminary assessment of the feeding habits of 127 taxa of pre-imaginal Coleoptera, Diptera, Ephemeroptera, Plecoptera, and Trichoptera from the La Trobe and Tanjil Rivers (Australia) was made from analyses of digestive tract contents and observations of captive specimens. Ultrafine (<50 micron) detritus was the dominant material in gut contents of all five orders, and fine (>50 micron-<1 mm) detritus (mostly leaf and wood fragments, benthic algae (especially diatoms), and remains of invertebrate prey also were important. Bacteria, fungi, and planktonic algae were present in minor quantities. Many species were capable of shredding dead leaves and wood. Dietary diversity was particularly high in the families Elmidae, Chironomidae, Leptophlebiidae, Gripopterygidae, and Leptoceridae. (Author's abstract)
W87-01082

NEMATODES, INCLUDING A NEW RECORD OF TOBRILUS DIVERSIPAPILLATUS IN AUSTRALIA, AS POTENTIAL INDICATORS OF SEWAGE EFFLUENT POLLUTION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
A. H. Arthington, G. W. Yeates, and D. L. Conrick.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 159-166, 1986. 3 fig, 40 ref. Department of National Development and Energy for Research (Australia) Project 78/100.

Descriptors: *Nematodes, *Tobrilus diversipapillatus, *Wastewater pollution, *Bioindicators, *Australia, Mermithidae, Biological oxygen demand, Organic enrichment, Toxins, Eutrophication, Bulimba Creek, Brisbane.

Nine nematode taxa were collected during a study of the effects of sewage effluent on benthic macroinvertebrates in Bulimba Creek, Brisbane (Australia). Tobrilus diversipapillatus, previously unknown from Australia, comprised 80% of the collection, and was most abundant at polluted sites with high biological oxygen demand and high levels of total organic carbon. Free-living adult and juvenile Mermithidae made up 15.6% of the collection and were most abundant at sites with low biological oxygen demand. The potential of T diversipapillatus and Mermithidae to serve as biological indicators of organic enrichment and toxic pollution is discussed in terms of the present findings and literature data. (Author's abstract)
W87-01084

RECONNAISSANCE LIMNOLOGY OF SOME COASTAL DUNE LAKES OF CAPE YORK PENINSULA, QUEENSLAND,
Avondale Coll. of Advanced Education, Cooranbong (Australia). Dept. of Science.
B. V. Timms.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 167-176, 1986. 2 fig, 5 tab, 19 ref.

Descriptors: *Limnology, *Cape York Peninsula, *Dunes, Australia, Hydrogen ion concentration, Sodium, Chlorides, Calcium, Magnesium, Bicarbonate, Macrophytes, Invertebrates, Fish, Zooplankton, Tropic zone, Endemism, Queensland, Laterite, Sandstone, Ions.

Nine small lakes (mean area 32 ha) were studied in Cape York Peninsula (Australia); all were shallow (<5 m deep) and had water table exposures in thin dunes overlying laterite or sandstone. Their water was fresh (mean salinity 52 mg/l), acid (mean pH 4.8), and dominated by Na(+) and Cl(-), but with appreciable amounts of Ca(2+), Mg(2+), and HCO3(-). Almost all macrophytes, littoral invertebrates, fish, and limnetic zooplankters were common tropical species. A few species are shared with dune lakes in southern Australia and even fewer were endemic. These tropical dune lakes therefore differ from those in temperate and subtropical eastern Australia. (Author's abstract)

W87-01085

CONDUCTIVITY AND SALINITY OF AUSTRALIAN SALT LAKES,
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 177-182, 1986. 1 fig, 1 tab, 19 ref.

Descriptors: *Conductivity, *Salinity, *Salt lakes, *Australia, Correlation analysis.

The relationship between conductivity (eta) and salinity (S) was investigated in 109 samples from 89 Australian salt lakes. Within the range of 5-100 milliSiemens/cm, the relationship is described by the equation: S = 0.4665 times eta to the 1.0878 power, with an r squared of 0.98799, where salinity is measured in g/l and conductivity in milliSiemens/cm at 25 C. A table based on this relationship is provided to enable rapid determination of salinity from conductivity. (Author's abstract)
W87-01086

LIGHT ATTENUATION IN A SMALL TROPICAL RESERVOIR (SOLOMON DAM, NORTH QUEENSLAND): SEASONAL CHANGES AND THE EFFECTS OF ARTIFICIAL AERATION,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
P. R. Hawkins, and D. J. Griffiths.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 199-208, 1986. 5 fig, 21 ref.

Descriptors: *Light attenuation, *Photosynthesis, *Phytoplankton, *Reservoirs, *Artificial aeration, Tripton, Australia, Solomon Dam, Tropical zone, Queensland, Gilvin, Seasonal distribution, Stratification, Hypolimnion.

Seasonal changes in light attenuation are described for Solomon Dam, Palm Island, north Queensland, and the attenuation characteristics are compared with those reported for other Australian water bodies. The major components of the water column that affect attenuation of photosynthetically available radiation (PAR) were studied for 4 yr, including 16 months when the reservoir was artificially aerated. The pattern of light attenuation varied at different times of the year, depending largely on the stratification conditions and on the dominant phytoplankton species. The vertical attenuation coefficient of PAR varied on a seasonal basis, the major peaks being related to periods of high phytoplankton densities. The only time tripton contributed significantly to attenuation of PAR coincided with the start of artificial aeration. Gilvin (yellow substance) concentrations in Solomon Dam were moderately high, especially in the hypolimnion of the strongly stratified reservoir. Artificial aeration moderated the range of seasonal fluctuations in light attenuation by reducing the density of phytoplankton in surface layers. (Author's abstract)
W87-01087

SEED BANK DYNAMICS IN A SOUTHEASTERN RIVERINE SWAMP,
Savannah River Ecology Lab., Aiken, SC.
R. L. Schneider, and R. R. Sharitz.
American Journal of Botany AJBOAA, Vol. 73, No. 7, p 1022-1030, July 1986. 2 fig, 2 tab, 24 ref. DOE Contract DE-AC09-76SR00819.

Descriptors: *Riverine swamps, *Seed banks, *Cypress, *Tupelo, *Seasonal distribution, *Flooding, Swamp forests, Bottomland hardwoods, Savannah River, South Carolina, Soils, Succession.

Seed banks were examined in a cypress-tupelo swamp forest and an adjacent bottomland hardwood forest on the floodplain of the Savannah River in South Carolina. Thirty 0.01 sq m soil cores were collected in each community at each of three sampling times: before seed fall, after seed fall, and after an early spring river level rise had inundated both communities. Germination and sieving techniques were used to enumerate seeds in each sample. Woody seed banks of the two communities were dissimilar in species composition with both underrepresenting the species composition of the standing vegetation. In contrast, herbaceous seed banks of both communities were similar in species composition , with greater species diversity in the seed banks than in the standing vegetation. Both the herbaceous and woody seed banks of the hardwood community changed significantly in seed densities across the three collection dates. Densities increased from September to December, after seed fall for many species, but decreased in April after the early spring water level rise. Seed densities did not change significantly in the cypress-tupelo community across the three collections. Hydrologic regime appears to have a major influence on seed bank composition and dynamics in southeastern riverine swamps. (Author's abstract)
W87-01091

PERIPHYTON AND MUSSELS IN MONITORING CHLOROHYDROCARBONS AND CHLOROPHENOLS IN WATERCOURSES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5A.
W87-01099

HABITAT DISTURBANCE AND THE STABILITY OF FRESHWATER GASTROPOD POPULATIONS,
Oxford Univ. (England). Dept. of Zoology.
D. M. Lodge, and P. Kelly.
Oecologia (Berlin), OECOBX, Vol. 68, No. 1, p 111-117, December 1985. 3 fig, 55 ref.

Descriptors: *Snails, *Gastropods, *Population dynamics, *Ecological distribution, Ecology, Aquatic habitats, Mollusks, Aquatic populations, Ponds, Macrophytes, Aquatic animals, Habitats.

The abundance and size structure of four species of macrophyte-associated freshwater snails ere studied in an English pond following a dramatic decline of submersed macrophytes. Lymnaea peregra and Valvata piscinalis are associated with submersed macrophytes, while Planorbis vertex and Bithynia tentaculata are associated with emergent macrophytes. Lymnaea exhibited low resistance to habitat disturbance but high adjustment following the disturbance. Valvata showed higher resistance than Lymnaea, and also high adjustment. Although the population stability of Planorbis and Bithynia could not be rigorously evaluated, it appears that stability, population stability, especially the adjustment component, was low. It is suggested that the population stability of the four species is a major determinant of the association of Lymnaea and Valvata with the impermanent macrophyte habitat and of Planorbis and Bithynia with the permanent macrophyte habitat. (Doria-PTT)
W87-01149

SPECIES NUMBERS OF VASCULAR PLANTS IN RELATION TO AREA, ISOLATION AND AGE OF PONDS IN DENMARK,
Copenhagen Univ. (Denmark). Inst. of Population Biology.
T. R. Moller, and C. P. Rordam.
OIKOS, Vol. 45, p 8-16, August 1985, 5 fig, 5 tab, 47 ref.

Descriptors: *Species composition, *Aquatic plants, *Denmark, *Ponds, *Population density, *Species diversity, Ecology, Ecological distribution.

Recent decrease of ponds in rural Denmark increase the distance among remaining ponds. This may have led to a decrease in the immigration rate of pond biotas, and hence to a lower equilibrium species number. This study attempts to evaluate dispersal abilities and requirements as an aid in conservation planning. In two districts with a different mean distance between ponds, the area of the shore plus low water is the best single predictor of vascular plant species numbers in the ponds. Ponds hold significantly more species per unit area in the district where ponds are closer. Partial correlation analysis indicates that area affects both the space for vegetational development and the immigration rate. Recently created or restored ponds display species numbers much higher than predicted by area. The influence of isolation is discussed in terms of a rescue-effect among close ponds. The need for better estimates of isolation with archipelagoes of small biotopes is stressed, and some components of a more precise estimate are proposed. (Doria-PTT)
W87-01150

SELECTIVE FEEDING BY STREAM CADDISFLY (TRICHOPTERA) DETRITIVORES ON LEAVES WITH FUNGAL-COLONIZED PATCHES,
New Mexico State Univ., Las Cruces. Dept. of Biology.
T. L. Arsuffi, and K. Suberkropp.
OIKOS, Vol. 45, No. 1, p 50-58, August 1985. 6 fig, 28 ref.

Descriptors: *Caddisflies, *Leaves, *Stream biota, *Fungi, Ecology, Aquatic life, Detritus, Organic matter.

A leaf in a stream represents a mosaic of fungal-colonized areas or 'patches', which may differ in fungal composition and stage of processing. However, little is known about the ability of detritivores to locate and discriminate among these fungal-colonized patches as food sources. To assess this ability, the authors manipulated fungal colonization patterns on leaves and fed them to caddisfly detritivores. Feeding patterns, determined by visual ranking of leaf skeletonization, indicated that larvae fed selectively on fungal-colonized patches. Larval choice was affected by fungal species and degree of colonization. Larvae were able to detect fungal hyphae associated with patches before physical changes had occurred in the leaf matrix. Observations of foraging larvae and the feeding patterns they exhibited suggest that these caddisflies view individual leaves as coarse-grained resources. (Doria-PTT)
W87-01151

TEMPORAL STUDY OF COLLOIDAL AND DISSOLVED ORGANIC CARBON IN RIVERS: APPARENT MOLECULAR WEIGHT SPECTRA AND THEIR RELATIONSHIP TO BACTERIAL ACTIVITY,
University Coll. of North Wales, Bangor. School of Animal Biology.
T. E. Ford, and M. A. Lock.
OIKOS, Vol 45, No. 1, p 71-78, August 1985. 3 fig, 4 tab, 40 ref.

Descriptors: *Colloids, *Organic carbon, *Rivers, *Chemical properties, *Bacteria, Chemical analysis, Water properties, Carbon, Clywedog River, Aber River, Wales, Rainfall.

Colloidal and dissolved organic carbon (C/DOC) from the Clywedog and Aber rivers in North Wales was fractionated at monthly and quarterly intervals, respectively, during a 13-month study, into five apparent molecular weight (AMW) fractions: 0.7 micrometers - 300K, 300K - 50K, 50K - 10K, 10K - 1K, and < 1K. Somewhat consistent patterns emerged throughout the year, suggesting that apparent molecular weight 'signatures' are buffered to change. The densities and proportions of actively metabolizing epilithic bacteria were not significantly correlated with any AMW fraction. In contrast, the density and proportions of actively metabolizing bacteria in suspension in the Clywedog river were positively correlated with the < 1K fraction. Rainfall, as an index of river discharge at the Clywedog river, was negatively correlated with epilithic bacterial activity and relationships between temperature and bacterial activities and suspended bacterial densities were very significant. (Doria-PTT)
W87-01152

NITROGEN METABOLISM OF THE SHALLOW AND DEEP-WATER PHYTOPLANKTON IN A SUBALPINE LAKE,

Montana State Univ., Bozeman. Dept. of Biology.
J. C. Priscu, R. P. Axler, and C. R. Goldman.
OIKOS, Vol. 45, No. 1, p 137-147, August 1985. 5 fig, 1 tab, 57 ref.

Descriptors: *Metabolism, *Nitrogen, *Phytoplankton, *Lakes, Aquatic plants, Plankton.

Experiments utilizing N-15 were performed during the 1979 and 1980 ice-free seasons in the shallow and deep-chlorophyll layers of Castle Lake, California to determine the effects of dissolved inorganic nitrogen (DIN) concentration on the rates of DIN assimilation. The half-saturation constant for the assimilation of nitrate was about 12 micrograms per liter in the epilimnion and mid-hypolimnion, and increased to about 50 micrograms per liter in the aphotic-lower hypolimnion. A similar pattern was evident for ammonium ions in 1979 but not 1980. The trend in K values paralleled the availability of DIN to the phytoplankton at the various depths. Relatively low ammonium ion enrichments strongly inhibited assimilation of nitrate at 3 m. Assimilation of nitrate was less sensitive to ammonium ion at 20 m and was not affected by ammonium ion concentration up to about 75 micrograms per liter at 25 m. The seasonal persistence of the deep-water phytoplankton maximum in Castle Lake appears to be dependent to a large extent on the adaptations of these organisms to the ambient DIN supply. (Doria-PTT)
W87-01133

DEVELOPMENT OF HABITAT TIME SERIES,
Fish and Wildlife Service, Fort Collins, CO. Cooperative Instream Flow Service Group.
R. T. Milhous.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 112, No. 1, p 145-148, January 1986. 4 fig, 5 ref.

Descriptors: *Habitats, *Water management, *Stream discharge, *Time series analysis, *Mathematical studies, Simulation, Model studies, Aquatic habitats, Resources management, Mathematical analysis.

A physical habitat versus streamflow function can be used as a surrogate for an economic production function. The physical habitat represents the space in a river that can be used as habitat represents the space in a river that can be used as habitat by a specific species and life stage of fish. The river space available for recreation also can be simulated as a function of streamflow. The Physical Habitat Simulation System (PHABSIM) simulates the physical habitat versus streamflow function as a surrogate production function, the assumption is made that the value of the instream flows is related to the habitat produced by the flows. It is desirable to know the time series of benefits that fish habitat produced. The technique used to transform the time series of streamflows to a time series of physical habitat uses the habitat versus streamflow function as a transformation function. (Doria-PTT)
W87-01160

APPLICATION OF A LAKE-WATERSHED MODEL FOR THE DETERMINATION OF WATER BALANCE,
Alberta Univ., Edmonton. Dept. of Geology.
A. S. Crowe, and F. W. Schwartz.
Journal of Hydrology, JHYDA7, Vol. 81, p 1-26, October 30, 1985. 7 fig, 9 tab, 37 ref.

Descriptors: *Lakes, *Surface-ground water relations, *Model studies, *Hydrologic budget, *Groundwater, Subsurface water, Catchment areas, Groundwater basins, Wabamun Lake, Alberta, Conductance, Chloride, Potassium.

A lumped-parameter, lake-watershed response model was developed for the Wabamun Lake system (Alberta, Canada) and used to assess the role of groundwater in the water balance of the lake. The surrounding watershed is covered by a thin layer of glacial sediments, which in turn overlie bedrock deposits of sandstone, siltstone, shale, and coal. Good agreement has been achieved between the monthly observed and monthly predicted lake stages for a 26-year record, with a maximum difference of less than 0.25 m. In addition, the simulation of lake chemistry including specific conductance, chloride and potassium, is in good agreement with the observed data.. According to the simulations, the main hydrologic components contributing water inflow (36.8 - 48.3%) and the groundwater system (35.0 - 43.5%). Groundwater discharging to Wabamun Lake (1.3 - 8.6%) and surface water draining from the lake (0.0 - 18.5%) are minor components in the lake's water balance. (Author's abstract)
W87-01170

NUMERICAL LUMPED-PARAMETER MODEL FOR SIMULATING THE ISOTOPIC EVOLUTION OF CLOSED-BASIN LAKES,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
F. M. Phillips, M. A. Person, and A. B. Muller.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 73-86, June 15, 1986. 6 fig, 1 tap, 28 ref.

Descriptors: *Limnology, *Model studies, *Simulation, *Closed lakes, *Chemical properties, *Isotope fractionation, Lakes, Mathematical studies, Hydrologic budget, Evaporation, Temperature, Salinity, Humidity, Hydrology.

A wide variety of analytical solutions to differential equations has been used successfully to model the isotopic evolution of lakes. However, application of this type of model is limited, since many lakes exhibit varying fluxes and environmental conditions that are not amenable to simple analytical solutions. A finite-difference lumped-parameter model which is flexible enough to accommodate fluctuating water balances as well as varying temperature, humidity, and salinity (with its effects on the chemical activity of water and the isotopic fractionation factors) is presented. The model has been applied to the observed isotopic evolutions of Owens Lake (California) during a dessication episode, leading to the conclusion that anomalously light atmospheric vapor has strongly affected the course of the lake's isotopic evolution. (Author's abstract)
W87-01181

OUTFLOW SKEWNESS IN NON-SEASONAL LINEAR RESERVOIRS WITH GAMMA-DISTRIBUTED MARKOVIAN INFLOWS,
Inland Waters Directorate, Ottawa (Ontario).
D. Warren.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 127-137, June 15, 1986. 2 fig, 7 ref, append.

Descriptors: *Model studies, *Hydrologic budget *Markov process, *Mathematical studies, *Reservoirs, storage, Catchment areas, Precipitation.

A linear reservoir model is examined and a method is given for finding the skewness of the outflows when the inflows are modeled by a certain non-seasonal Markov chain with gamma marginal distribution. This involves obtaining the lower moments of a weighted sum of Markovian variables, which is achieved by exploiting a result of Lloyd and Saleem concerning the Laplace transform (LT) of such a sum. (Doria-PTT)
W87-01184

VEGETATION STRUCTURE AND PRIMARY PRODUCTION IN ACIDIFIED LAKES IN SOUTHWESTERN SWEDEN,
Swedish Environmental Research Inst., Fryksta.
O. Grahn.
Experientia EXPEAM, Vol. 42, No. 5, p 465-470, May 15, 1986. 7 fig, 2 tab, 21 ref.

Descriptors: *Acid lakes, *Vegetation effects, *Primary productivity, *Lakes, *Ecological effects, *Acid rain, Productivity, Biomass, Sphagnum, Species composition, Oligotrophic lakes.

Of all documented biological changes in acidified lakes, the effect on macropohyte succession, in particular that of Sphagnum, is the most striking. These changes have brought about major shifts in the composition of the primary producers. The biomass in one lake was estimated to be 6.5 t (dry weight) corresponding to about 24 g per sq m; the proportions were 52% for Sphagnum, 34% for Lobelia, and 15% for Isoetes. Percentage production in the whole lake is 54% for Sphagnum, 29% for Lobelia, and 17% for Isoetes, which gives an estimated production of 2.9 t/yr or 9 g per sq m per year. Sphagnum is a recent element, and its occurrence is related to the acidification of the lakes. The growth of Lobelia is reduced in acid lakes compared to other oligotrophic lakes due to shading by the benthic mat of filamentous algae, detritus, and Sphagnum debris. It is suggested that liming of lakes may cause elimination of Sphagnum and some increase4 in the production of Isoetids. (Doria-PTT)
W87-01209

EFFECTS OF ACID DEPOSITION ON BENTHIC ANIMALS IN LAKES AND STREAMS,
Oslo Univ. (Norway). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-01210

IMPACT OF ACIDIFICATION ON PHYTOPLANKTON AND ZOOPLANKTON COMMUNITIES,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5C.
W87-01211

EFFECTS OF WATER ACIDIFICATION ON THE DISTRIBUTION PATTERN AND THE REPRODUCTIVE SUCCESS OF AMPHIBIANS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5C.
W87-01212

EFFECTS OF EXPERIMENTAL ACIDIFICATION ON FRESHWATER ENVIRONMENTS,
Commission of the European Communities, Ispra (Italy). Dept. of Physical and Natural Sciences.
For primary bibliographic entry see Field 5C.
W87-01213

MECHANISMS INFLUENCING THE CIRCULATION AND DISTRIBUTION OF WATER MASS IN A MEDIUM RESIDENCE-TIME LAKE,
National Water Research Inst., Vancouver (British Columbia).
E. C. Carmack, R. C. Wiegand, R. J. Daley, C. B. J. Gray, and S. Jasper.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 249-265, March 1986. 14 fig, 51 ref.

Descriptors: *Lakes, *Riverine circulation, *Mixed-layer dynamics, *Water circulation, *Internal wave behavior, *Internal waves, Residence time, Waves, Rivers, Kootenay Lake, Thermal stratification, Stratification, Seasonal variation, Mixing.

The seasonality of physical structure in a deep temperate lake (Kootenay Lake) is described in relation to its major river inputs (Kootenay and Duncan Rivers). The lake's volume is 37 cu km and its annual outflow is 25 cu km per year, yielding a residence time of about 1.5 years. Water mass distributions are controlled by the interactions of three processes: riverine circulation, mixed-layer dynamics, and internal wave behavior. The riverine circulation is determined by the inflow rate and by the relative density of incoming water and ambient lake water. Mixed-layer structure varies in relation to the combined action of the wind and surface heat flux on both seasonal and synoptic time scales. Internal waves may periodically raise a given stratum of water, such as the riverine layer, to a depth where winde mixing is more intense. Knowledge of these processes, their relative importance, and their time-space variability can aid in understanding the ecology of the lake. (Author's abstract)
W87-01226

RELEVANCE OF SCAVENGING KINETICS TO MODELING OF SEDIMENT-WATER INTERACTIONS IN NATURAL WATERS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5B.
W87-01228

METABOLIC ACTIVITIES IN FLOCCULENT SURFACE SEDIMENTS AND UNDERLYING SANDY LITTORAL SEDIMENTS,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
For primary bibliographic entry see Field 5B.
W87-01230

IN SITU PARTICLE GENERATION IN A SOUTHERN SWEDISH STREAM,
Lund Univ. (Sweden). Limnological Inst.
R. C. Petersen Jr.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 432-437, March 1986. 1 fig, 2 tab, 19 ref.

Descriptors: *Streams, *Abiotic particle generation, *Waterfalls, *Particulate matter, *Organic matter, Organic carbon, Aquatic habitats, Habitats, Verkean River, Sweden.

An increase in the number of particles was measured below a waterfall in a southern Swedish stream. Particulate organic carbon (POC) increased below the falls by 0.12 mg C per liter, 5% of the total POC present. Dissolved organic carbon decreased by 0.1 mg C per liter but was not significant and inorganic content remained unchanged. The number of Celloscope-measured particles in the size range of 2-20 microns increased below the falls, with a 66% increase in particles of 4-6 microns diameter. Although POC generation was small it was greater than published allochthonous input rates to streams. Abiotic particle generation, although extremely difficult to measure, may be far more important to carbon dynamics in stream ecosystems than previously thought. (Author's abstract)
W87-01232

AQUATIC PLANTS OF ACID LAKES IN KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA; FLORISTIC COMPOSITION AND RELATION TO WATER CHEMISTRY,
Department of Agriculture, Ottawa (OntariO0
For primary bibliographic entry see Field 5C.
W87-01234

WOODY RIPARIAN VEGETATION OF A LAKE SUPERIOR TRIBUTARY,
Minnesota Univ.-Duluth. Dept. of Biology.
K. A. Ericsson, and D. J. Schimpf.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 4, p 769-773, April 1986. 8 fig, 3 tab, 13 ref.

Descriptors: *Rivers, *Vegetation, *Riparin vegetation, Sucker River, Minnesota, Tributaries, Lake Superior, Trees, Conifers, Forests, Pine trees, Ash trees, Alder trees, Spruce trees, Fir trees, Cedar trees, Birch trees.

Woody vegetation along the lower 16 km of the Sucker River (a lake Superior tributary in Minnesota) was surveyed as a precursor to leaf decomposition studies. Vegetation composition and its relation to the environment were assessed. The most abundant trees and shrubs were Alnus rugosa, Abies balsamea, Cornus stolonifera, and Fraxinus spp. The lower, steeper 10 km of the river was bordered by coniferous forest, above which was 3 km of Alnus thicket, then 3 km of mixed conifer-hardwoods along the flatter reaches farther inland. Alnus rugosa and Thuja occidentalis decreased dramatically in numbers a short distance from the river. Abies balsamea and Betula papyrifera showed the reverse trend. Polar ordinations revealed that riparian species composition was correlated with the gradient of the river but not with the aspect of the stream banks. The riparian vegetation was less distinct from the surrounding vegetation than is often the case with larger streams. (Author's abstract)
W87-01235

EMPIRICAL PREDICTION OF CRUSTACEAN ZOOPLANKTON BIOMASS IN NUTRIENT-POOR CANADIAN SHIELD LAKES,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
N. D. Yan.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 788-796, April 1986. 4 fig, 8 tab, 47 ref.

Descriptors: *Lakes, *Limnology, *Nutrients, *Zooplankton, Crustaceans, Biomass, Water temperature, Temperature, Prediction, Phosphorus, Ontario, Nitrogen, Phytoplankton, Chlorophyll, Model studies.

A comparison of the predictive power of nine existing empirical zooplankton biomass models indicated that lake water phosphorus concentration may be a better predictor of zooplankton biomass in Canadian Shield lakes than phytoplankton biomass, chlorophyll a, midsummer epilimnetic temperature, mean surface water temperature, mean depth, and Carlson's trophic state index. To develop models specifically applicable to nutrient-poor Canadian Shield lakes, a variety of morphometric, chemical, and planktonic parameters were assessed for three consecutive years from 16 Canadian Shield lakes in south-central Ontario. Total nitrogen was the best univariate predictor of zooplankton biomass for data averaged over single ice-free seasons, but total phosphorus was the best predictor when data were averaged over the entire study period. Consideration of pH and maximum depth improved certain models. Total phosphorus is clearly a good predictor of (long-term) average zooplankton biomass in nutrient-poor lakes as it is in lakes exhibiting a wide range in trophic state. (Author's abstract)
W87-01244

TROPHIC STATUS OF 19 SUBARCTIC LAKES IN THE YUKON TERRITORY,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
K. S. Shortreed, and J. G. Stockner.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 797-805, April 1986. 7 fig, 5 tab, 44 ref.

Descriptors: *Lakes, *Limnology, *Trophic level, Nutrients, Phosphorus, Nitrogen, Phytoplankton, Eutrophication, Mesotrophy, Oligotrophy, Zooplankton, Water quality, Yukon Territory, Subarctic lakes, Chlorophyll.

Limnological investigations were carried out on 19 Yukon River basin lakes in the summer of 1982 and on 10 of the lakes in March 1983. Their surface areas ranged from 1.6 to 90 sq km and the mean depths from 2.5 to 93 m. Regression analyses were carried out using various chemical and biological areas. Based on range in total phosphorus concentrations (3.2-12.9 micrograms/liter) average chlorophyll levels (0.62-3.76 micrograms/liter), and average bacterioplankton numbers (780,000 to >10 million per ml), most lakes were oligotrophic, several were mesotrophic, and one was close to eutrophy. Particulate concentrations of phosphorus, nitrogen and carbon indicated that most lakes were predominantly phosphorus limited, but in a number, nitrogen was also important in limiting phytoplankton production. The picoplankter Synechococcus sp. was the most abundant phytoplankton species, and common zooplankters were Cyclops scutifer, Daphnia spp., and Diaptomus pribilofensis. (Author's abstract)
W87-01245

EVALUATION OF FACTORS RELATED TO THE UNUSUALLY LOW CHLOROPHYLL LEVELS IN PRAIRIE SALINE LAKES,
Alberta Univ., Edmonton. Dept. of Zoology.
C. E. Campbell, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 846-854, April 1986. 1 fig, 5 tab, 68 ref.

Descriptors: *Lakes, *Chlorophyll, *Limnology, *Saline lakes, Phosphorus, Alberta, Nitrogen, Phytoplankton, Periphyton, Nutrients, Zooplankton, Bacteria, Biomass, Model studies.

Prairie saline lakes in Canada have remarkably low chlorophyll a (Chl a) levels relative to total phosphorus (TP) and total nitrogen (TN) levels. To evaluate factors related to low Chl a levels, three Alberta saline lakes (total dissolved solids >5 g/liter) were studied in 1983 and 1984. Mean summer phytoplankton Chl a ranged from 3 to 10 micrograms per liter, mean summer periphyton Chl a was less than 70 mg per sq m, while mean summer TP and TN ranged from 2 to 13 and from 4 to 11 mg per liter, respectively. Chl a and phytoplankton primary production were extremely low relative to predictions from measured TP and TN levels and empirical models for freshwaters. Bioassays indicated that inorganic phosphorus was not limiting, whereas inorganic nitrogen was limiting algal growth. Bacterial densities and zooplankton dry weight were high (>10 million cells per ml and >1.0 mg per liter, respectively) relative to predictions from Chl a and empirical models for freshwaters. Phytoplankton biomass was insufficient to maintain the zooplankton populations; bacteria and detritus were likely a major food source for zooplankton. This study suggests that freshwater models are not applicable to prairie saline lakes. (Author's abstract)
W87-01248

FISH FAUNAL STRUCTURE IN AN OZARK STREAM: STABILITY, PERSISTENCE AND A CATASTROPHIC FLOOD,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews.
Copeia, No. 2, p 388-397, May 1986. 1 fig, 2 tab, 42 ref.

Descriptors: *Rivers, *Fish, *Floods, Piney Creek, Ozark Mountains, Arkansas, Species composition, Habitats, Aquatic habitats, Aquatic animals, Ecology.

In December 1982 widespread, physically catastrophic flooding occurred in the Ozark Mountains of northern Arkansas. In the Piney Creek watershed (Izard County) flooding resulted in an immediate change in rank order abundance of numerically dominant fishes and moderate alteration in composition of the entire fauna. At badly scoured locations, local assemblages of fishes were markedly altered. These changes in the fish fauna of Piney Creek exceeded seasonal changes in the fishes that were found in an earlier, no-flood year. The Piney Creek fish fauna showed rapid recovery from the flood, however, and by August 1983, eight months later, the total fish fauna and the local fish assemblages closely resembled those of August 1982, before the flood. Comprehensive sampling of the watershed in 1972, 1973, 1981 (in part), 1982, and 1983 suggests that the fish fauna was stable (via elasticity) and persistent across years, seasons and a drastic flood. (Author's abstract)
W87-01253

HABITAT USE AND POSITIONAL BEHAVIOR OF ANURAN LARVAE IN A NORTHERN FLORIDA TEMPORARY POND,
Duke Univ., Durham, NC. Dept. of Zoology.
R. A. Alford.
Copeia, No. 2, p 408-423, May 1986. 10 tab, 30 ref.

Descriptors: *Lakes, *Amphibians, *Limnology, *Aquatic habitats, *Species distribution, Anurans, Frogs, Toads, Fowler's toads, Habitats, Larval growth stage, Ponds, Tadpoles, Florida, Temperature, Water temperature, Aquatic plants, Macrophytes.

Anuran larvae using temporary ponds face unpredictable resource abundances and levels of competition. Any mechanisms for the reduction of competition must be flexible enough to operate under widely differing circumstances. This study examined differences in habitat use and behavior within and among four species of anuran larvae (Rana utricularia, Limnaeodus ocularis, Pseudacris ornata

and Bufo terrestris) coexisting in a northern Florida temporary pond. These species differed in habitat use: their relative abundances in samples were determined in part by aspects of the physical environment (position along the long axis of the pond, percent ground cover by the aquatic macrophyte Sagittaria subulata and water temperature). Absolute numbers in samples of two of the species (Limnaoedus and Pseudacris) were determined by combinations of water temperature, location along the long axis of the pond and percent cover by Sagittaria, Hydrocotyle umbellifera, sand and other plants. The positions of both species relative to the environmental parameters changed over time, suggesting changes in habitat use with growth and development or changes in habitat quality. Individuals of three species (Rana, Limnaoedus and Bufo) differed in snout-vent length (SVL) among samples within dates. Mean SVL in samples was correlated with aspects of the physical environment in Rana and Limnaoedus. These results suggest that individuals of different sizes within species may differ in habitat use. Two species (Rana and Bufo) showed correlations between their numbers in samples and the numbers of one or more of the other species present. These correlations changed over time. The results suggest that the tadpoles were partitioning the available resources through differences in microhabitat use. Some of the observed differences in position among species may have been due to interspecific avoidance. Laboratory experiments using all possible pairwise combinations of the four species in an environment devoid of asymmetrical positional cues showed that Rana (the largest species) and Limnaeodus (the smallest species) were positioned farther from members of other species than from conspecifics. This result adds support to the suggestion that interspecific differences in distribution observed in the field may be due in part to avoidance among individuals of different species or sizes. (Author's abstract)
W87-01254

SHORT-TERM VARIATIONS IN THE PIGMENT COMPOSITION OF A SPRING PHYTOPLANKTON BLOOM FROM AN ENCLOSED EXPERIMENTAL ECOSYSTEM,
Institute of Oceanographic Sciences, Wormley (England).
For primary bibliographic entry see Field 5C.
W87-01275

ENERGY OF SEA WIND WAVES AND PRINCIPLES OF ITS CONVERSION,
V. V. Volshanik, and G. V. Matushevskii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 207-213, October 1985. 2 fig, 1 tab, 13 ref. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Energy, *Energy sources, *Wind waves, *Mathematical studies, Waves, Wind.

The possibility of using the energy of wind waves as a renewable energy resource has received attention. This paper proposes a new method of determining the average long-term power of waves, along with the first classification of wave power plants (WPPs) according to the energy principle of their operation. (Doria-PTT)
W87-01379

ENZYMATIC HYDROLYSIS OF PROTEINACEOUS PARTICULATE AND DISSOLVED MATERIAL IN AN EUTROPHIC LAKE,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
For primary bibliographic entry see Field 5B.
W87-01456

UREA METABOLISM AND ITS SIGNIFICANCE IN THE NITROGEN CYCLE IN THE EUPHOTIC LAYER OF LAKE BIWA: I. IN SITU MEASUREMENT OF NITROGEN ASSIMILATION AND UREA DECOMPOSITION,
Osaka Kyoiku Univ. (Japan). Lab. of Environmental Science and Education.
O. Mitamura, and Y. Saijo.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 1, p 23-51, July 1986. 8 fig, 8 tab, 73 ref.

Descriptors: *Lake Biwa, *Ureas, *Limnology, *Lakes *Chemical reactions, *Nitrogen cycle, Nitrogen, Metabolism, Ammonia, Nitrates, Decomposition, Japan.

To clarify the behavior of urea in nitrogen metabolism, in situ experiments were carried out in the euphotic layer at three stations having different trophic characteristics in freshwater Lake Biwa. Over the entire study, the contribution of urea, ammonia and nitrate in the total nitrogen assimilation accounted for 0.0 to 53.9% (average; 20.0%), 41.7 to 99.4% (average; 73.8%) and 0.0 to 35.2% (average; 6.2%), respectively. The contribution for urea and ammonia in the smaller fraction (<25 micrometers) was similar to those in the total fraction. The daily C/N assimilation ratio was calculated as 5.5 to 12.0 (by weight) in the surface water at three stations showing a different character, and had a similar value to that of the PC/PN ratio in the particulate matter. The diel variation of nitrogen assimilation and urea decomposition correlated with variations of solar radiation. The phase for urea and ammonia assimilation in periodicity corresponded to that for nitrate, although the amplitude was much lower than for nitrate. The turnover rate for urea was calculated as 2.2 to 20.9 days, for ammonia 1.4 to 3.0 days and for nitrate 86 to 294 days in the surface water and increased with depth. Doubling times of particulate nitrogen in the surface water were 1.9 to 4.4 days and increased with depth. The distribution of the urea decomposition rate resembled closely that of urea nitrogen assimilation. The ratio of urea carbon decomposition to urea nitrogen assimilation which was expressed as unit molar urea was 0.98. (Lantz-PTT)
W87-01457

DEMISE OF MEROMIXIS IN RIVERINE LAKES OF THE WORLD HERITAGE WILDERNESS OF SOUTH-WEST TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
L. C. Bowling, and P. A. Tyler.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 1, p 53-73, July 1986. 9 fig, 3 tab, 29 ref.

Descriptors: *Meromictic lakes, *Meromixis, *Tasmania, *Gordon River, *Lake Fidler, *Lake Morrison, Flow regulation, Powerplants, Water pollution effects, Chemical analysis, Holomixis, Lakes.

Three shallow, riverine lakes in the World Heritage Area of south-west Tasmania depend, for the maintenance of their meromictic state, on the periodic intrusion of brackish water derived from a wedge of marine water, penetrating the Gordon River. The presence of bacterial photosynthetic pigments throughout the sediment profile indicates a long history of meromixis. Regulation or flow in the river, for hydroelectric power generation, now prevents salt water from penetrating sufficiently far upstream and the meromictic condition of the lakes has declined. In Lake Fidler meromictic stability has fallen and the level of the chemocline, relative to datum, dropped continuously since power station discharge commenced. The lake is still meromictic, with a chemocline 1.2 m lower than in former times. In Sulphide Pool a similar trend is evident and the monimolimnion is now limited to a few centimeters. This lake is likely to become holomictic in the near future. Lake Morrison became holomictic soon after power station operation commenced. It is closer to the river's mouth than the other two lakes and there is evidence that brackish water may still enter the lake periodically. Since regulation of flow, it has vacillated between holomixis and incipient meromixis, but the salinity of its bottom waters, during periods of incipient meromixis, is much less than during its former meromictic condition, insufficient to prevent holomixis. (Lantz-PTT)
W87-01458

LIGHT CLIMATE OF A SMALL DEEP LAKE (PIBURGER SEE, AUSTRIA) AND ITS INFLUENCE ON PHYTOPLANKTON PRODUCTION,
Innsbruck Univ. (Austria). Botanisches Inst.
E. Rott.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 1, p 89-117, July 1986. 12 fig, 2 tab, 60 ref.

Descriptors: *Light intensity, *Lakes, *Piburger See, *Phytoplankton, *Limnology, *Photosynthesis, Austria, Productivity, Seasonal variation, Radiation, Chlorophyll.

The influence of light on phytoplankton photosynthesis in the mesotrophic and meromictic Piburger See was investigated by the temporal analysis of the components of the underwater light climate. The annual time course of global radiation is affected by topographical screening of the horizon, which accentuates the difference in energy income between summer and winter. From December to April additional light attentuation by the winter cover causes a limitation of photosynthesis. During the ice-free seasons the vertical light gradient (of the most penetrating component) controls the structure of the photosynthesis depth profile. In spring, however, the maximum phytoplankton density in mid-depth layers causes irregular vertical distribution of photosynthesis. Phytoplankton is highly productive in near-surface layers in summer, as is shown by the maximum photosynthetic capacity found, i.e. 7.9 mg C/unit chlorophyll/hr. (Author's abstract)
W87-01459

STRUCTURE AND DYNAMICS OF THE FRENCH UPPER RHONE ECOSYSTEMS: 28. PRODUCTION ESTIMATION OF GAMMARIDS (STRUCTURE ET FONCTIONNEMENT DES ECOSYSTEMES DU HAUT-RHONE FRANCAIS. 28. ESTIMATION DE PRODUCTION DE GAMMARES),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
P. J. Dessaix.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 1, p 125-141, July 1986. 6 fig, 7 tab, 19 ref.

Descriptors: *Rhone River, *France, *Ecosystems, *Gammarids, *Productivity, Canals, Biomass, Reservoirs, Statistical analysis, Graphical analysis.

From April 1975 to May 1979, four successive annual production estimates were calculated for the Upper Rhone in France. Gammarids were sampled in the 'canal de Jonage' by means of artificial substrates. During the last year, from April 1978 to May 1979, two other collecting places were sampled: the 'canal de Miribel' and the river just before its separation into the 2 canals. The annual production estimates range from 12.2 to 175.7 g fresh weight per artificial substrate, whereas the turnover ratio P/B is almost constant (3.4 to 4.2). Annual biomass, and therefore annual production are largely influenced by some factors of the ecosystem, mainly the discharge. In June 1978, the emptying and cleaning of the Genissiat reservoir strongly disturbed the populations of the main stream and of the 'canal de Jonage'. These results are compared with those obtained by applying the Allen curve to average cohorts. (Author's abstract)
W87-01461

SIMPLE AND INEXPENSIVE MONITOR FOR RECORDING OXYGEN AND TEMPERATURE IN LAKES AND RESERVOIRS,
King's Coll., London (England). Dept. of Human Environmental Science.
For primary bibliographic entry see Field 7B.
W87-01469

THREE DECADES OF POST-IMPOUNDMENT DATA ON THE LITTORAL FAUNA OF LLYN TEGID, NORTH WALES,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 4C.
W87-01480

TOWARDS A THEORY OF MACROINVERTEBRATE COMMUNITY STRUCTURE IN STREAM ECOSYSTEMS,

Idaho State Univ., Pocatello. Dept. of Biology.
G. W. Minshall, and R. C. Petersen, Jr.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 1, p 49-76, July 1985. 7 fig, 4 tab, 29 ref.

Descriptors: *Macroinvertebrates, *Ecosystems, *Streams, *Limnology, Benthic fauna, Population dynamics, Statistical analysis, Ecological distribution.

A theory is presented to explain the development of stream benthic invertebrate community structure. Support for these ideas is drawn from published works and from studies conducted by the authors and their colleagues. It is proposed that species composition on individual rocks or substratum patches occurs in a manner analogous to the MacArthur-Wilson model for colonization of oceanic islands. Immigration to and emigration from these habitat 'islands' occurs primarily via drift. Thus the processes of invertebrate drift and the formation and maintenance of benthic community structures are seen to be inextricably linked. Species accumulation over time follows a sigmoid pattern with the early (nonequilibrium) phases characterized by random, noniterative conditions and the later (equilibrium) phases featuring directed, interactive conditions. The theory serves to reconcile the apparent conflict as to whether stochastic or deterministic factors are of primary importance in the structuring of stream invertebrate communities and suggests that even in seemingly variable stream environments equilibrium conditions are found often and long enough to be of importance in the formation of stream community structure. It also suggests an inherent difference between the stage of development, and hence the type of community association found in stable versus unstable sections of streams. (Author's abstract)
W87-01481

GROWTH CHARACTERISTICS OF AEROMONAS HYDROPHILA IN LIMNETIC WATERS OF VARYING TROPHIC STATE,
Rhode Island Univ., Kingston. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-01482

BACTERIAL GLUCOSE UPTAKE IN THE WATER BODY OF THE EDER RESERVOIR (WEST GERMANY)(ZUR BAKTERIELLEN GLUCOSEAUFNAHME IM WASSERKOERPER DER EDERTALSPERRE),
Frankfurt Univ. (Germany, F.R.). Fachbereich Biologie.
V. J. C. Tamm, G. Fricke, J. Overbeck, and L. Steubing.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 321-335, July 1985. 6 fig, 21 ref.

Descriptors: *Glucose, *Limnology, *Bacterial physiology, *Eder Reservoir, *West Germany, Reservoir, Growth kinetics, Eder River, Oxygen, Hydrogen ion concentration, Eutrophication.

In the Eder Reservoir, a large river impoundment in West Germany, bacterial glucose uptake rates were observed which correspond with those known of other considerably euproductive fresh water ecosystems in Europe. The three parameters of uptake kinetics - V sub max (maximum potential rate of uptake or 'heterotrophic capacity'), K sub t (reciprocal to substrate affinity) and T sub t (turnover time) - show characteristics correlations: K sub t and T sub t vary strongly and mostly proportionally, while V sub max shows no noticeable relations to the two factors. Several algal blooms occurred in the reservoir's superficial standing water (sampling depth 1 m) together with high pH values (up to 10.5) and considerable oxygen supersaturation (max. 300%) in daylight, as well as reduced total numbers of bacteria. Glucose uptake was often inefficient and more defective than in 4 m depths, or further upstream the Eder river itself. In running water, where plankton effects were negligable, glucose uptake frequently was high, effective and largely in compliance with Michaelis-Menten kinetics. V sub max values in standing water were mostly lower, less variables, and in proportion to the total number of bacteria. Various non-kinetic parameters indicated a noticeable improvement of the reservoir's standing water quality with increasing proximity of the dam wall. On the other hand, uptake kinetic data only reflected this vaguely. (Lantz-PTT)
W87-01483

PROTOZOAN ABUNDANCES IN THE PLANKTON OF TWO TROPICAL LAKES,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, Jr.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 337-343, July 1985. 2 fig, 1 tab, 14 ref.
NSF Grants DEB76-04300 and DEB78-05324.

Descriptors: *Protozoa, *Limnology, *Plankton, *Lakes, *Growth dynamics, *Lake Valencia, *Venezuela, *Lake Lanao, *Phillipines, Biomass, Tropical regions, Flagellates, Bacteria.

Quantitative counts were made of protozoans in the euphotic zone of Lake Valencia, Venezuela, over a two-year interval and in Lake Lano, Phillippines, over a one-year interval. In Lake Lanao, the annual average abundance of protozoans was 1900 individuals per cc, corresponding to 260,000 cu micrometers/cc. Over 75% of individuals and of biomass was accounted for by very small flagellates. Large flagellates, ciliates, and amoeboid forms accounted for the remainder of the protozoans in Lake Lanao. In Lake Valencia, the average protozoan abundance was 350 individuals per cc, corresponding to 109,000 cu micrommeters/cc. Ciliates and amoeboid forms dominated in Lake Valencia. Comparisons of protozoan biomass with the known phytoplankton turnover rates of the two lakes, indicates that protozoans cannot be an important source of phytoplankton mortality. Protozoans may have important effects on bacterial populations in Lake Lanao, but these effects seem less likely in Lake Valencia. (Author's abstract)
W87-01484

OBSERVATIONS ON LAKES NEAR MOUNT ST. HELENS: PHYTOPLANKTON,
Goldsmiths' Coll., London (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W87-01485

DYNAMICS OF CHLOROPHYLL AND PHOTOSYNTHESIS IN NATURAL PHYTOPLANKTON ASSOCIATIONS: II. PRIMARY PRODUCTIVITY, QUANTUM YIELDS AND PHOTOSYNTHETIC RATES IN SMALL NORTHGERMAN LAKES,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W87-01486

FACTORS CONTROLLING PHYTOPLANKTON POPULATION IN A BOG, MATSUMIKE, JAPAN,
Tokyo Univ. of Fisheries (Japan).
K. Shiraishi, Y. Uno, Y. Hara, and H. Seki.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 387-406, July 1985. 15 fig, 1 tab, 21 ref.
Ministry of Education of Japan Grant No. 574800004.

Descriptors: *Phytoplankton, *Limnology, *Population dynamics, *Bogs, *Matsumi-ike, *Japan, Marshes, Wetlands, Lake Kasumigaura, Kami-ike, Nitrates, Nitrogen, Ammonia, Chlorophyll, Temperature, Phosphates.

A bog, Matsumi-ike, located at a typical marsh in Tsukuba Science City, has two basins with different characteristics. One basin, Shimo-ike, matured naturally as a representative bog in the watershed of Lake Kasumigaura, without direct influence from human activity. Another basin, Kami-ike, was dredged and its margin was embanked in 1976. The effect of environmental factors on the growth of the phytoplankton community was clear in Shimo-ike, but was less clear in Kami-ike. For growth of the phytoplankton community in the bog, the limiting factor was shown to be temperature. Nonlimiting factors had profound effects in the order of nitrate, total inorganic nitrogen, and ammonium. Environmental factors had almost the same effects on the growth of Nitzschia species in the chlorophyll-c group of the phytoplankton community. The limiting factor was temperature, and the effect of non-limiting factors was greater in the order of nitrate and phosphate. However, Chlamydomonas species in the chlorophyll-b group of the phytoplankton community showed a different reaction to the environmental factors; phosphate was the limiting factor, and the effect of non-limiting factors was greater in the order of temperature, nitrate and total inorganic nitrogen. The nutrient concentrations for the optimum growth of phytoplankton in the bog were theoretically determined as 20 microgm-at N/L for total inorganic nitrogen, several micrograms-at N/L for nitrate and 1 microgram-at P/L for phosphate. (Lantz-PTT)
W87-01487

BUOYANCY REGULATION AND CHROMATIC ADAPTATION IN PLANKTONIC OSCILLATORIA SPECIES: ALTERNATIVE STRATEGIES FOR OPTIMISING LIGHT ABSORPTION IN STRATIFIED LAKES,
National Inst. of Public Health, Oslo (Norway).
H. C. Utkilen, O. M. Skulberg, and A. E. Walsby.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 407-417, July 1985. 2 fig, 2 tab, 31 ref.

Descriptors: *Buoyancy, *Chromatographic adaptation, *Limnology, *Plankton, *Lakes, Oscillatoria, Light adsorption, Light penetration, Stratification.

On the basis of investigations into ten planktonic strains of Oscillatoria it is proposed that they may employ three distinct strategies of optimizing their use of the natural light field. Green-colored strains may exploit the higher light intensities of the epilimnion of lakes. These strains have weak gas vesicles that may be regulated by turgor pressure to provide a method for controlling buoyancy in shallow waters. Red-colored strains may be adapted to absorbing the green light reaching the deeper metalimnion where there forms may stratify. Their buoyancy is provided by stronger gas vesicles that can withstand the greater hydrostatic pressures in deeper lakes. A third type of Oscillatoria strain, which lacks gas vesicles and would be unable to regulate its buoyancy, exhibits chromatic adaptation and should be able to adjust its light absorption according to the incident light field at different depths. These different strategies would permit the different species to occupy different limnetic niches. (Author's abstract)
W87-01488

SELECTIVE INHABITATION OF PARASITIC CYANOPHYTE PSEUDANABAENA IN WATER-BLOOM MICROCYSTIS COLONIES,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W87-01489

REACIDIFICATION MODEL FOR ACIDIFIED LAKES NEUTRALIZED WITH CALCITE,
Lund Univ. (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W87-01531

PHOSPHORUS ADSORPTION TO RIVERINE SUSPENDED MATTER: IMPLICATIONS FOR THE P-BUDGET OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
H.-H. Stabel, and M. Geiger.
Water Research WATRAG, Vol. 19, No. 11, p 1347-1352, 1985. 5 fig, 2 tab, 21 ref.

Descriptors: *Adsorption, *Phosphorus, *Suspended solids, *Lake Constance, *Rivers, Chemical

properties, Lakes, Phosphorus removal, Sediments, Suspended sediments.

Dissolved phosphorus from Lake Constance water was adsorbed by particulate matter from the Alpenrhein whenever the equilibrium phosphorus concentration of 0.85 micromol per liter was exceeded. When shaken in phosphate-free lake water, the solids liberated small amounts of P (1% of the total-P). The maximum adsorption capacity of the particles was estimated to be 2.8 micromol per gram (dry substance). Only part of the phosphorus desorbed in P-free lake water. During 1981, 1.47 x 10 to the 9th power kg of particulate matter was discharged into Lake Constance from the Alpenrhein. These sedimenting materials had the potential to remove by adsorption 18,000 to 25,000 kg of dissolved phosphorus from the water column, comprising almost 2% of the total P-load. (Author's abstract)
W87-01546

TOTAL DISSOLVED PHOSPHORUS: EFFECTS OF TWO MOLECULAR WEIGHT FRACTIONS ON PHOSPHORUS CYCLING IN NATURAL PHYTOPLANKTON COMMUNITIES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
J. C. Auclair, P. Brassard, and P. Couture.
Water Research WATRAG, Vol. 19, No. 11, p 1447-1453, 1985. 5 fig, 2 tab, 32 ref.

Descriptors: *Limnology, *Phytoplankton, *Phosphorus, *Phosphorus cycling, *Mathematical studies, *Aquatic environment, Aquatic plants, Plankton, Biomass, Lakes, Radioisotopes, Community dynamics.

Although 32P-uptake kinetics enable the closed mathematical treatment of the phosphorus cycle, several P pools, other than PO4, do not achieve isotopic equilibrium, indicating that the P system could be open to P sources not labeled by the tracer. The authors tested whether such sources supporting an open system could produce significant changes in phytoplankton biomass in two lakewater communities. Two fractions were concentrated from natural lakewaters ranging from 2,000 to 10,000 daltons (fraction I) and 10,000 to 100,000 daltons (fraction II). These were then reintroduced to the natural communities at three concentration levels, and the capacity of the added organic matter to deliver phosphorus to the P cycle was assessed. Although the fractions decreased growth and increased phosphatase activity and PO4 uptake rate constants, this could not be attributed to an additional delivery of P to the community. However, the effects could be explained by non-P organic matter such as dissolved humic materials acting either directly upon the community, or on phosphorus kinetics. The effects appeared to be pH-dependent. It is suggested that outside Spring P loading or other sporadic P inputs, the natural community tends to operate within a closed P system, where community dynamics are more strongly affected by non-P organic matter than by organic phosphate inputs. (Author's abstract)
W87-01560

INCREASED MICROSPORIDIAN PARASITISM OF THE CRAYFISH ORCONECTES VIRILIS IN AN EXPERIMENTALLY ACIDIFIED LAKE,
Department of Fisheries and Forestry, Winnipeg (Manitoba).
R. L. France, and L. Graham.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 2, p 129-136, October 1985. 3 fig, 2 tab, 36 ref.

Descriptors: *Microsporidians, *Parasitism, *Crayfish, *Orconectes, *Acid rain, *Acid lakes, *Thelohania, *Acidified lakes, Crustaceans, Lakes, Aquatic environment, Parasites, Infection, Chemical properties, Acidity.

Orconectes virilis has been identified as a host of the microsporidian Thelohania contejeani in four lakes in the Experimental Lakes Area (ELA), northwestern Ontario. Prevalence of parasitism increased from 1.7% in autumn 1979, to 6.5% and 7.7% in autumns 1980 and 1981 concomitant with experimental acidification of Lake 223 to pH 5.1. Mean infection rates observed within three reference lakes were between 0.3 to 0.6%. Enhanced microsporidosis is believed to have contributed to a reduction in annual crayfish survival rates for the Lake 223 population of 8% in 1979 and 18% in 1980 compared to averages calculated for the non-acidified lakes. Hypotheses to explain the ten-fold increase in Thelohania parasitism in Lake 223 over background levels for the ELA region include: increased propagative ability due to elevated rate of crayfish cannibalism or low pH-favored parasite life cycle; and decreased host resistance when under sublethal stress. (Author's abstract)
W87-01564

RATE OF LAKE ACIDIFICATION IN FOUR LAKES NORTH OF LAKE SUPERIOR AND ITS RELATIONSHIP TO DOWNCORE SULPHUR ISOTOPE RATIOS,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W87-01570

PHYTOPLANKTON PRIMARY PRODUCTION, STANDING CROP AND SPECIES SUCCESSION IN THE TONGUE RIVER RESERVOIR, MONTANA,
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. C. Whalen, S. A. Leathe, and R. W. Gregory.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 493-511, October 1985. 6 fig, 5 tab, 31 ref.

Descriptors: *Phytoplankton, *Primary productivity, *Limnology, *Standing crops, *Tongue River Reservoir, *Montana, Reservoirs, Seasonal variation, Cryptophyta, Cyanophyta, Algal blooms, Bacillariophyceae, Dyanophyceae.

For one year, phytoplankton primary production, standing crop and species succession were examined at three locations in the Tongue River Reservoir, a run of the river impoundment in southeastern Montana. Annual phytoplankton primary production totalled 248 g C/sq m with 5% of the productivity occurring under ice cover (mid-November through mid-April). Cryptophyta and Bacillariophyceae dominated the under-ice biota. Bacillariophyceae was also the most prominent algal group during the ice-free growing season but was augmented or replaced by blooms of Dinophyceae (Glenodinium gymnodinium) and Cyanophyta (Aphanizomenon flos-aquae) during August through October. At the mid-reservoir sampling site the mean annual chlorophyll-a and phytoplankton standing crop were 8.5 micrograms/L and 2.61 cu mm/L. Nearly synoptic sampling showed distinct site to site differences in the magnitude and composition of the phytoplankton standing crop. This was related to longitudinal physicochemical gradients caused by the down reservoir transition from riverine to lacustrine conditions. (Author's abstract)
W87-01600

HEAVY METALS IN LAKE KINNERET (ISRAEL): I. TOTAL COPPER AND CUPRIC ION CONCENTRATIONS IN LAKE KINNERET AND THE RIVER JORDAN,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-01602

POPULATION GROWTH RATE OF THE BACTERIOPLANKTON COMMUNITY IN A BOG, MATSUMI-IKE, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Naganuma, and H. Seki.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 543-556, October 1985. 7 fig, 48 ref. Ministry of Education of Japan Grant No. 574800004.

Descriptors: *Population dynamics, *Bacterioplankton, *Bogs, *Matsumi-ike, *Japan, Ecological effects, Mesotrophy, Dissolved organic matter, Food chains.

Every ecological factor in the Matsumi-ike showed a steady-state oscillation in a range near the eutrophic part of the mesotrophic system. In this bog, the population growth rate of natural bacterioplankton community was determined with a chemostat. The rate was regulated by the concentration of dissolved organic matter as the limiting factor. It was also affected profoundly by nonlimiting factors, primarily by the population density of bacterioplankters themselves and secondly by temperature. By a series of natural feedback loops as influenced by these environmental factors in the bog, the generation time of bacterioplankters within the 95% confidence interval was maintained in the range between 5 and 20 hours. (Lantz-PTT)
W87-01603

ACTIVE NITRIFICATION IN THE HYPOLIMNION OF LAKE KIZAKI IN EARLY SUMMER: 1. NITRIFYING ACTIVITY OF RAPIDLY SINKING PARTICLES,
Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01604

OSCILLATORIA CF. AGARDHII VAR. ISOTHRIX SKUJA FROM THE LAKES OF AMVRAKIA AND TRICHONIS, GREECE: A TAXONOMIC CONSIDERATION,
Athens Univ. (Greece). Dept. of Biology.
K. Anagnostidis, J. Overbeck, and D. Danielidis.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 205-217, August 1985. 10 fig, 69 ref.

Descriptors: *Lake Amvrakia, *Lake Trichonis, *Greece, *Taxonomy, *Cyanophyceae, *Oscillatoria, Classification, Pigments.

The presence in lakes Amvrakia and Trichonis, Greece, of an Oscillatoria species (Cyanophyceae) closely related to the members of the Prolificae, allows for a re-examination of the problematic diagnostic criteria involved in the systematics of these taxa. It is evident that the Oscillatoria found in lakes Amvrakia and Trichonis presents clear similarities with both O. rubescens and O. agardhii var. isothrix on the one hand, and with O. mougeotii on the other. Identification with O. rubescens is not possible because of the difference in color of trichomes and the lack of data about the main water-soluble pigment of the material. These features, although not resolute as diagnostic criteria, can not be ignored. The only significant difference between O. agardhii var. isothrix and the test material, was the observed attentuation of the trichomes. This feature is of limited application and has been previously reported for var. isothrix. Presently, the organism is classified as Oscillatoria cf. agardhii var. isothrix, until more is known about its pigments, trichomes attenuation and its ecological niche. It must also be emphasized that according to the descriptions of O. mougeotii and O. mougeotii f. major, there seems to be no sufficient diagnostic criteria for the distinction and maintenance of these two taxa. Moreover, there is a stronger than currently accepted relationship between O. mougeotii and O. agardhii var. isothrix. Both seem to occupy the same ecological niche and are characterized by the same water-soluble pigment viz. phycocyanin. (Lantz-PTT)
W87-01606

DYNAMICS OF CHLOROPHYLL AND PHOTOSYNTHESIS IN NATURAL PHYTOPLANKTON ASSOCIATIONS: I. SEASONAL AND ANNUAL CYCLES OF CHLOROPHYLL AND PHAEOPIGMENTS, IN RELATION TO EUPHOTIC DEPTH AND THEIR VERTICAL DISTRIBUTION IN SMALL NORTHGERMAN LAKES,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-01607

STRUCTURE, CELL DIFFERENTIATION AND LIFE CYCLE OF BLUE-GREEN ALGA NODULARIA HARVEYANA (THWAITES) THURET,
National Botanical Research Inst., Lucknow (India).
A. Dixit, D. V. Amla, and P. N. Saxena.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 235-245, August 1985. 5 fig, 23 ref.

Descriptors: *Cyanophyta, *Nodularia harveyana, *Life cycles, *Cell differentiation, Morphology, Population dynamics, Algal growth, Spores.

Morphology, cell differentiation and life-cycle of Nodularia harveyana (THWAITES) THURET have been studied. Occurrence of the alga in nature is periodic, because it prefers low temperature, high humidity and a pH between 7 to 9.5 for luxuriant growth. N. harveyana bears four types of cells: vegetative, heterocysts, akinetes and disc-shaped dead cells. The shape of vegetative cells, heterocysts, and the pattern of akinete formation are stable, while sheath and morphology of akinetes and dead cells are variable. The heterocysts are terminal, intercalary, single or in pairs, and are not completely suppressed by combined nitrogen sources. Akinete formation always starts midway between the two heterocysts, and gradually most of the cells are differentiated into akinetes. The frequency of spore germination is quite high, and the first cell of the four-celled germling differentiates into the first heterocyst irrespective of the nitrogen sources. The dead cells differentiate among the vegetative cells and also near the heterocysts and akinetes. The alga reproduces through fragmentation, hormogonia and spores. The taxonomic importance of the alga in the order Nostacales is discussed. (Author's abstract)
W87-01608

ALTERATION OF IRON-CACO3 PRECIPITATION BY YELLOW ORGANIC ACIDS OF AQUATIC ANGIOSPERM ORIGIN,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
R. G. Wetzel, and W. S. White.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 247-251, August 1985. 1 fig, 25 ref. DOE Grant EY-76-S-02-1599 and COO-1599-249, and NSF Grant BMS-75-20322.

Descriptors: *Iron, *Calcium carbonate, *Organic acids, *Aquatic life, *Angiosperms, *Chemical reactions, Ethylenediaminetetraacetic acid, Lakes, Water pollution, Hydrogen ion concentration, Chemical precipitation, Chemical analysis.

Dissolved organic compounds can affect the equilibria and biogeochemical cycling of inorganic nutrients in a number of complex ways. Trivalent iron is usually near or below analytical detectability in alkaline, hardwater lakes. Iron occurs in most aerobic lake waters as particulate or colloidal ferric hydroxide, adsorbed onto particulate matter, and in complexes with natural organic compounds. As a result, even though iron loading to a hardwater lake ecosystem may be high, the availability of a micronutrient such as iron to phytoplanktonic algae can be sufficiently low to be periodically limiting, in conjunction with other factors, to high rates of photosynthesis. Addition of EDTA or of yellow organic acids from decomposing macrophytes at a concentration within the range occurring in natural lake water enhanced the availability of iron in complexed but soluble form to concentrations (15 and 32 micrograms/L, respectively) that would be metabolically significant to phytoplanktonic algal requirements. The synthetic EDTA and natural yellow organic acids also increased markedly the amount of iron in complexed form from natural sources in the lake water at pH values of 8.3 and 8.5, even though these compounds themselves contained no significant amounts of iron. Yellow organic acids from decomposing plants and EDTA reduced the rates of CaCO3 precipitation. Under natural lake water conditions, 21% of the CaCO3 precipitated at pH 9.0, and 50% at pH 9.5. Only 3.7% of the CaCO3 precipitated at pH 9.0 in the presence of EDTA, and addition of yellow organic acids reduced the CaCO3 precipitation to 2.2% at the concentrations employed. At pH 9.5, these concentrations of the complexing compounds were ineffective in preventing CaCO3 precipitation. (Lantz-PTT)
W87-01609

DYNAMICS OF THE ZOOPLANKTONIC POPULATIONS FROM LAKE GAMELIN, QUEBEC (DYNAMIQUE DES POPULATIONS ZOOPLANCTONIQUES DU LAC GAMELIN, QUEBEC),
Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.
L. -M. Lalancette, C. Tudorancea, and O. Tremblay.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 253-268, August 1985. 7 fig, 3 tab, 38 ref.

Descriptors: *Lake Gamelin, *Quebec, *Zooplankton, *Population dynamics, Rotifers, Copepods, Cladocera, Seasonal variation, Population density.

From October 1977 to October 1978, 429 planktonic samples were collected from Lake Gamelin. The analysis of these samples showed that Lake Gamelin contained 17 zooplanktonic species: 6 Rotifers, 5 Copepods, and 6 Cladoceran species. Cyclops scutifer and Keratella longispina composed the most important group with Polyarthra vulgaris, Trichocera cylindrica and Diaptomus minutus the subdominating species. The other species were scare and Cladocera were never abundant. The zooplanktonic average density was 33.1 ind./L during the year with extremes of 20.8 to 53.0 ind./L obtained during the months of March and October. In terms of numeric abundance, Copepods represented 53%, Rotifers 41%, and Cladocera 6% of the total zooplankton. (Author's abstract)
W87-01610

GAMMARIDS IN STREAMS OF NORTHEASTERN BAVARIA, F.R.G.: II. THE DIFFERENT HYDROCHEMICAL HABITATS OF GAMMARUS FOSSARUM KOCH, 1835 AND GAMMARUS ROESELI GERVAIS, 1835,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
F. Foeckler, and E. Schrimpff.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 269-286, August 1985. 3 fig, 6 tab, 25 ref.

Descriptors: *Gammarids, *Bavaria, *Germany, *Chemical analysis, Ecology, Water pollution effects, Potassium, Magnesium, Conductivity, Chlorides.

Within Northeastern Bavaria, two Gammarus species exists: G. fossarum KOCH and G. roeseli GERVAIS. Their distribution is restricted to well buffered, Mg and Ca rich streams. An attempt is made to discriminate between the species' habitats, by hydrochemical, natural, or anthropogenic variables, in order to find out the main ecological differences. Eighty-three stream sections of 13 streams with gammarids were used to obtain test samples. The measured variables were water temperature, specific conductivity, pH, total hardness, concentrations of Ca, Mg, K, Cl(-), NO3(-), PO4(3-), Fe, Zn, and organic matter. Principal Component Analysis and Multivariate Discriminant Analysis were applied to determine the best discriminating variables between three groups: G. fossarum habitat, G. roeseli habitat, both species together. Out of the 14 variables evaluated, only 4 were relevant for the discrimination of G. fossarum and G. roeseli habitats: K, Mg, specific conductivity, and Cl(-). Sites with the presence of both species are fairly rare (<10% of all) and were transitional between the pure one-species habitats. (Lantz-PTT)
W87-01611

ECOPHYSIOLOGICAL STUDIES ON ACID TOLERANCE OF GAMMARUS FOSSARUM (OKOPHYSIOLOGISCHE UNTERSUCHUNGEN ZUR SAURETOLERANZ VON GAMMARUS FOSSARUM (KOCH),
Gesamthochschule Kassel (Germany, F.R.). Inst. fuer Zoologie.
For primary bibliographic entry see Field 5C.
W87-01612

INTER- AND INTRA-HABITAT DISTRIBUTION OF LEECHES IN A EUTROPHIC ENGLISH LAKE,
Liverpool Univ. (England). Dept. of Zoology.
S. M. L. Randall, S. M. Spelling, and J. O. Young.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p 419-444, June 1985. 12 fig, 9 tab, 35 ref.

Descriptors: *Leeches, *Eutrophic lakes, *Population density, Ecological distribution, England, Helobdella stagnalis, Erpobdella octoculata, Glossiphonia complanata, Population dynamics, Biomass, Water depth.

Helobdella stagnalis was the most numerous leech on stones, vegetation and detritus in an ion-rich, eutrophic, English lake, though in some months Erpobdella octoculata dominated in vegetation and detritus. Glossiphonia complanata was the least abundant species in vegetation and detritus, but was second most abundant on stones. For any one species, populations on stones and on vegetation/detritus had similar weight-structures, breeding periods, and proportions of mature animals. Samples from stones of five different size-categories and two different surface textures, indicated no significant difference in the abundance of each of the leech species at three different depths in the shallow littoral, except in a mid-winter sample, when there was evidence of movement into deeper waters. Leeches showed no preference for stones of a particular size-class or texture. For all three species, the density and biomass of leeches were less on stones than in the underlying substratum. In contrast, for each species, the population on stones had a greater mean individual weight and a relatively greater proportion of breeding animals. Collections from deeper waters using divers, artificial substrates and an Ekman grab indicated that leeches had their maximum abundance within 1 m, decreased dramatically between 1 and 2 m, and were very scare from 2 to 8 m. Reasons for observed distribution patterns are discussed. Findings are compared with those obtained in other studies. (Lantz-PTT)
W87-01614

RESPONSES OF PHYTOPLANKTON IN LAKE JACARETINGA TO ENRICHMENT WITH NITROGEN AND PHOSPHORUS IN CONCENTRATIONS SIMILAR TO THOSE OF THE RIVER SOLIMOES (AMAZON, BRAZIL),
Universidade Estadual Paulista, Botucatu (Brazil). Inst. Basico de Biologia Medica e Agricola.
For primary bibliographic entry see Field 5C.
W87-01615

GAMMARIDS IN STREAMS OF NORTHEASTERN BAVARIA, F.R.G.: I. PREDICTION OF THEIR GENERAL OCCURRENCE BY SELECTED HYDROCHEMICAL VARIABLES,
Fachhochschule Weihenstephan, Freising (Germany, F.R.). Fachbereich Landespflege.
E. Schrimpff, and F. Foeckler.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p 479-495, June 1985. 3 fig, 7 tab, 21 ref.

Descriptors: *Gammarus, *Bavaria, *Germany, *Population dynamics, *Chemical analysis, Population density, Acidic water, Water analysis, Magnesium, Calcium, Hydrogen ion concentration, Stream biota.

The occurrence of gammarids in Northeastern Bavaria is restricted to the well buffered streams of the scarplands (Frankische and hersbrucker schweiz). Gammarids avoid the acidic waters, poor in ions, of the ancient earthblock area (Fichtelgebirge, Frankenwald) and of the ferrugineous sandstone areas within the scarplands. Testing the 13 analyzed hydrochemical parameters for their discriminant power (F-test) between the occurrence and nonoccurrence of gammarids, three (Mg, Ca, and pH) proved to be the most efficient. A simple discriminatory model built up on these variables yields 96% correct predictions within Northeastern Bavaria. The sensitivity analysis demonstrates the predominant role of Mg followed by Ca and pH. Mg appears to be a minimum factor for gammarids, since concentrations <10 mg/L Mg, lead

to an absence of gammarids. There is no evidence that Mg could be toxic in concentrations up to 40 mg/L. The model's efficiency decreases somewhat (86% correct predictions), when applied in near areas south and west of Northeastern Bavaria, but is not useful for areas of fairly different geohydrochemical and biological conditions, as e.g. the Schlitz area. (Lantz-PTT)
W87-01616

INFLUENCE OF THE MOBILITY OF POTAMOPYRGUS JENKINSI (SMITH, E.A.) (PROSOBRANCHIA:HYDROBIIDAE) ON ITS SPREAD,
University of the South Pacific, Suva (Fiji). School of Natural Resources.
A. Haynes, B. J. R. Taylor, and M. E. Varley.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p 497-508, June 1985. 3 fig, 4 tab, 17 ref.

Descriptors: *Potamopyrgus jenkinsi, *Population density, *Water currents, *Avon River, *England, *Snails, Flow velocity, Stream biota.

Since first reported from the Thames Estuary in 1859, Potamopyrgus jenkinsi has spread widely through European watercourses. Experiments in the river Avon showed that the number of P. jenkinsi moving upstream, compared with those moving downstream, was significantly greater at current speeds above 10 cm/sec. As the current speed increased, the numbers moving upstream became more significant, until at a current speed of 30 cm/sec,. 36 out of 37 snails moved upstream. Flow chamber experiments reinforced this point and showed that more P. jenkinsi of all sizes turned into the current and moved upstream, as the current speed increased. Small P. jenkinsi (1.0-1.9 mm high) are more likely to be washed away at lower current speeds (e.g. 13.9 cm/sec) than adult snails because the small snails are unable to hold the substrate as well. The turning of P. jenkinsi upstream can be explained, in part at least, by the mechanical force of the current on the shell. This was demonstrated using a wax model in the flow chamber. P. jenkinsi are eaten by trout, and when voided live, they often give birth to many young. P. jenkinsi have spread quickly and extensively because they can be carried (a) by water fowl from one river system to another, and (b) by fish within a river or canal system and they can move actively upstream in a fast flowing river or stream. (Lantz-PTT)
W87-01617

LOWLAND HARDWOOD WETLAND INVERTEBRATE COMMUNITY AND PRODUCTION IN MISSOURI,
D. C. White.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p 509-533, June 1985. 1 fig, 13 tab, 40 ref.

Descriptors: *Wetlands, *Invertebrates, *Missouri, *Ecosystems, Hardwood, Isopods, Amphipods, Clams, Drought resistance, Drought, Water deficit, Flooding, Population dynamics.

The invertebrate communities of 3 lowland hardwood wetlands in southeastern Missouri, were described according to their strategy for tolerating or avoiding drought and period of recruitment to the community. The wetlands are dominated by isopods, amphipods and fingernail clams, group 1 permanent residents with limited means of dispersal that oversummer in the dry basin as adults. Lowland hardwood wetlands varied in the initiation and duration of the wet period from mid-October - late April (green tree reservoir, managed - GTR), late December - late April (naturally flooded, early NFE), to late February - late April (naturally flooded, late NFL). Invertebrate standing stock averaged 1.37 g/sq m on the GTR. Growth of isopods was directly related to the initiation of flooding and length of the wet period. The largest isopods were always found on the site with early flooding and long wet periods (GTR). Female isopods on those sties were largest and carried the most eggs. Isopod production on GTR was 1.79 g/sq m by the size frequency method and annual turnover ratio was 3.8. Amphipods grew slowly on lowland hardwood wetlands during winter. Though average weights of adults were highest on GTR, they were not significant until 21 April. Because winter growth is limited, early flooding may not be an important factor in amphipod production. Production on GTR was 0.134 g/sq m by the size frequency method and annual turnover ratio was 3.54. Reproduction of the Sphaeriidae is continuous and several generations of clams were present on the study sites. Individuals on NFE and NFl appeared larger than on GRT. Production on GTR was 0.456 g/sq m by the size frequency method and annual turnover ratio was 3.88. (Lantz-PTT)
W87-01618

DIFFERENTIATION OF THE COENOSES OF HELMINTHES AND ANNELIDA IN EXPOSED LOTIC MICROHABITATS IN MOUNTAIN STREAMS,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
P. Schwank.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p 535-543, June 1985. 3 fig, 4 tab, 7 ref.

Descriptors: *Coenoses, *Helminthes, *Annelids, *Lotic environment, *Mountains, Streams, Nematodes, Rotifers, Oligocheates, Turbellaria, Food chains, Differentiation.

In the mountain streams of Central Europe, Turbellaria, Oligochaeta, Nematoda and Rotifera are strongly dependent on substrate type. Highly specialized coenoses live in the mosses on stones in lotic areas. The coenoses are rich in species and quite different from those on other substrates. Coenoses on the more exposed bare stone surfaces, and also those on layers of diatoms between ripple areas of floating sand, are less diverse. There are few species of Rotatoria Monogononta which are dominant: Cephalodella forceps and Encentrum martes. Both species feed upon the diatoms covering stones and sand. However, they do it in different ways. While E. martes uses its acute trophi like tweezers and swallows even big algal cells whole, C. forceps grinds or crushes the algae with its rounded trophi and sips in the cellular liquid. C. forceps is dominant in autumn, E. martes in winter and spring. (Lantz-PTT)
W87-01619

NUTRIENT AND METAL CONCENTRATIONS IN THE SURFACE SEDIMENT LAYERS OF THE KITKAJARVI LAKES,
Water District Office of Oulu (Finland).
U. Myllymaa, J. Saarelainen, and P. Hyvonen.
National Board of Waters, Finland. Water Research Institute Publication No. 62, 1985. p 20-53, 23 fig, 4 tab, 45 ref.

Descriptors: *Trace metals, *Nutrients, *Water chemistry, *Sediment concentration, *Lake sediments, *Kitkajarvi Lakes, Finland, Hydrogen ion concentration, Organic matter, Flow rates, Oxidation-reduction potential, Laminar flow, Iron, Manganese, Lead, Mercury, Calcium, Magnesium, Copper, Zinc, Kuusamo, Posio, Correlation analysis.

The amounts and distributions of metallic elements in the surface sediment layers of the Kitkajarvi lakes in the communes of Kuusamo and Posio were investigated. The metals examined were iron, manganese, copper, zinc, lead, cadmium, mercury, calcium and magnesium, the concentrations of which were expressed as percentages on a dry weight basis. In addition, the nutrients total nitrogen and total phosphorus were investigated in lake Yli-Ktika. Sediment concentrations were found to be: iron between 0.44 and 25.95%, manganese between 0.005 and 5.91%, copper between 7 and 119 ppm, zinc between 7 and 141 ppm, lead between 1 and 64 ppm, and cadmium between 0.05 and 1.0 ppm. Calcium concentrations were between 0.01 and .35%, Magnesium concentrations were between 0.04 and .61%, and mercury between 0.01 and .61 ppm. Of the factors affecting metal concentrations in surface sediments, the most important were found to be the pH-E sub h conditions prevailing in the water, and the amount of organic material in the sediment. In the Kitkajarvi lakes, the most important reasons are probably sedimentation variations, resulting from lamination of the lake water and regional differences in flow rates. In some areas upflow of bottom water and the resulting precipitation of iron-manganese complex affects the elemental balance. Regional differences in the underlying rock and soil do not cause such clear differences in the sediments as those sometimes observed in small lakes. However, the variation justifies a closer examination of the bedrock in different parts of the lakes. Calcium concentrations give the clearest indication of the location of its original source. (Lantz-PTT)
W87-01740

INFLUENCE OF DRAINAGE AREA FACTORS ON THE WATER QUALITY OF SMALL LAKES IN THE KOUTAJOKI RIVER BASIN WITH SPECIAL REFERENCE TO METALS,
Water District Office of Oulu (Finland).
V. Myllymaa.
National Board of Waters, Finland. Water Research Institute Publication No. 62, 1985. p. 54-92, 6 fig, 10 tab, 55 ref, append.

Descriptors: *Drainage area, *Water chemistry, *Lakes, *Water quality, *Koutajoki River, *Trace metals, Geochemistry, Bedrock, Soil types, Finland, Heavy metals, Turbidity, Chemical oxygen demand, Chlorophyll a, Color, Hydrogen ion concentration, Conductivity, Alkalinity, Chemical properties.

The extent to which the quality of water in small lakes depends on the physical and chemical properties of the immediate drainage area was investigated. Special attention is given to metals. The material Water quality data on 131 lakes more or less in a natural state, were obtained from the basic survey of water quality in the watercourses of this area. The research area consists of the Koutajoki river basin in Kuusamo, where five sub-systems have been investigated. The area is divided into three classes on the basis of the quality of the bedrock and into four classes on the basis of the quality of the soil. The findings of the work clearly indicate that the geochemical properties of both the bedrock and the soil influence the water quality of the lakes. With regard to the other drainage area factors, the percentages of mire and lake coverage were highly influential in some cases. Wintertime heavy metal concentrations of some lakes suggest a need to explore the bedrock for possible exceptionally high metal contents. (Author's abstract)
W87-01741

CORRELATIONS BETWEEN WATER QUALITY VARIABLES IN FINNISH LAKES,
J. Niemi.
National Board of Waters, Finland. Water Research Institute Publication No. 62, 1985. p 93-98, 4 tab, 12 ref.

Descriptors: *Correlation analysis, *Water quality, *Finland, *Lakes, Nutrients, Phytoplankton, Alkalinity, Conductivity, Color, Chemical oxygen demand, Turbidity, Iron, Phosphorus, Chlorophyll a, Chlorophyta, Nitrogen, Data interpretation.

Relationships between chemical and biological water quality variables were investigated by applying linear correlation analysis to two series of data gathered from Finnish lakes. The first series consisted of chemical water quality variables and total phytoplankton biomass and phytoplankton divisions analyzed in 136 lakes in 1977. The second consisted of chemical water quality variables analyzed in 160 lakes during the period 1976-1981. In both series the strongest correlations between chemical state variables were found between alkalinity and conductivity, color and iron, color and COD, iron and COD and turbidity and total phosphorus. The strongest correlations between biological state variables and between biological and chemical state variables were found between Chrysophyta and total phytoplankton and chlorophyll-a and total phytoplankton. Chlorophyll-a had a fairly strong correlation with Chlorophyta, total

residue, Cyanophyta, total nitrogen, alkalinity and total fixed residue. (Author's abstract)
W87-01742

MATHEMATICAL MODELING OF TWO FINNISH LAKES,
J. Niemi.
National Board of Waters, Finland. Water Research Institute Publication No. 62, 1985. p 99-104, 13 ref.

Descriptors: *Mathematical models, *Finland, *Lakes, *Simulation analysis, Ice breakup, Lake Paijanne, Lake Pyhajarvi, Temperature, Dissolved oxygen, Nutrients, Biomass, Phytoplankton, Ecosystems.

A simulation model (FINNECO) was developed and applied to two Finnish lakes. The objective was to formulate a model that would be suitable for Finnish conditions. The model is one-dimensional, has numerous state variables, includes the effect of wind in mixing water and simulates the freeze-up and break-up of ice. The model was applied to Lake Pyhajarvi and to the northern subbasin of Lake Paijanne with the data sets of two and four years, respectively. A time scale of eight hours was used. In Lake Pyhajarvi, which has an occasionally anoxic hypolimnion, the model could only be calibrated but not verified. Despite some limitations of the model it appeared to describe the real lake ecosystem reasonably well. The model should be suitable for lakes in which the calculation of vertical water quality is important and which do not have extremely poor water quality e.g. anoxic hypolimnion. (Author's abstract)
W87-01743

EFFECT OF AIRBORNE MERCURY AND PEATLAND DRAINAGE ON SEDIMENT MERCURY CONTENTS IN SOME FINNISH FOREST LAKES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01746

ORIGIN AND LEVEL OF MERCURY IN FINNISH FOREST LAKES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01747

EFFECT OF WATER QUALITY ON THE MERCURY CONCENTRATION OF NORTHERN PIKE (ESOX LUCIUS, L.) IN FINNISH FOREST LAKES AND RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01748

CAUSES OF INCREASED FISH MERCURY LEVELS IN FINNISH RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01749

ORGANIC AND INORGANIC MERCURY IN THE FOOD CHAIN OF SOME LAKES AND RESERVOIRS IN FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-01750

SELENIUM AND MERCURY CONTENTS IN NORTHERN PIKE (ESOX LUCIUS, L.) OF FINNISH MAN-MADE AND NATURAL LAKES,
For primary bibliographic entry see Field 5B.
W87-01751

COMPARATIVE STUDY ON THE ESTIMATION OF HUMIC MATTER IN NATURAL WATERS,
Helsinki Univ. (Finland). Dept. of Limnology.
V. Pennanen, P. Kortelainen, and J. Mannio.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 80-87, 2 fig, 5 tab, 20 ref.

Descriptors: *Humic matter, *Finland, *Decomposing organic matter, *Lakes, *Artificial lakes, *Reservoirs, Organic carbon, Chemical oxygen demand, Manganese, Total organic carbon, Optical properties, Chromatography, Particulate matter, Colloids, Dissolved solids, Iron, Color.

Organic carbon (TOC, DOC, COD sub Mn) and some optical measurements (color, UV-VIS and fluorescence spectroscopy) were coupled with liquid chromatography to estimate aquatic humus in water from natural and artificial lakes. Thirty-six forest lakes and 10 reservoirs without domestic or industrial effluents were studied at winter stratification and autumn overturn. Subfractions with different A254/A420 ratios representing particles, colloids and dissolved material were separated, without prior separation of humic material from non-humic organic material and metals. The interference caused by iron was considerable, especially in samples containing particles and colloids with high iron contents. Generally, the high molecular weight (HMW) and low molecular weight (LMW) fractions could be grouped as follows: COD sub Mn, TOC, DOC, A254 and fluorescence were coupled with LMW fraction and color (and A420) with HMW fraction. The color thus indicated the variation of the HMW fraction, or the variation of iron present in colloids and particles. The monitoring of humic matter using non-specific measurements might be possible in homogeneous materials but several inorganic and organic interferences should be investigated before further application. (Smith-PTT)
W87-01752

CHARACTERISTICS OF THE ALLOCHTHONOUS ORGANIC MATTER IN FINNISH FOREST LAKES AND RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01753

STEADY-STATE MODEL FOR TWO HUMIC FRACTIONS,
National Board of Waters, Helsinki (Finland).
T. Frisk, and V. Pennanen.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 98-107, 11 fig, 3 tab, 16 ref.

Descriptors: *Humic matter, *Humic acids, *Decomposing organic matter, *Lakes, *Artifical lakes, *Finland, *Mathematical models, Hakojarvi, Kalajarvi, Seinajarvi, Colloids, Dissolved organic matter, Particulate matter, Total organic carbon, Sedimentation.

A steady-state mass balance model for two humic fractions is presented. In the model the input of humus to the lake and the output from the lake, the loss reaction of humus including decay and sedimentation, and the possible transfer reactions between the two fractions are taken into account. The loss coefficients of the fractions are linearly interdependent. The absolute values of the coefficients cannot, however, be determined using the steady-state approach of this study. The characteristic coefficients of the interdependence of the coefficients as well as the loss coefficients of total humus were calculated for three lakes: Hakojarvi, Kalajarvi, and Seinajarvi. The loss reaction of humus appeared to be much slower in lake Hakojarvi than in lakes Kalajarvi and Seinajarvi. This may have resulted at least in part from the longer detention time in lake Hakojarvi. In lakes Hakojarvi and Seinajarvi about half of the humus input was lost in decay and sedimentation reactions, whereas in lake Kalajarvi, an artificial lake, only one quarter was lost. (Author's abstract)
W87-01754

EFFECT OF ACIDIC PRECIPITATION ON AMPHIBIAN BREEDING IN TEMPORARY PONDS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-01755

2I. Water In Plants

LAKESHORE REVEGETATION STUDIES AT LAKE OAHE, SOUTH DAKOTA,
South Dakota Univ., Vermillion. Dept. of Biology.
For primary bibliographic entry see Field 4A.
W87-00872

SEED BANK DYNAMICS IN A SOUTHEASTERN RIVERINE SWAMP,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2H.
W87-01091

CARBOHYDRATE RESERVES AND REPRODUCTIVE DEVELOPMENT AT LOW LEAF WATER POTENTIALS IN MAIZE,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
M. E. Westgate, and J. S. Boyer.
Crop Science CRPSAY, Vol. 25, No. 5, p 762-769, September-October 1985. 10 fig, 1 tab, 34 ref.

Descriptors: *Plant water potential, *Corn, *Carbohydrates, *Reproducibility, Grain crops, Crop yield, Particle size, Photosynthesis, Plant growth, Plant tissues, Osmosis, Sugars.

The mobilization of stored, nonstructured carbohydrates was measured in maize during low water potentials imposed at silk emergence, early grain fill, mid-grain fill and maintained to maturity. Low leaf water potential completely inhibited photosynthesis and reproductive development depended entirely on reserves. Decreased seed size at early and mid-grain fills and cessation of silk emergence resulted in yield losses. All mobilized dry matter from the stems and a sizable fraction from the leaves was carbohydrate, and was depleted to the level at anthesis by maturity. When low water potential was imposed at silk emergence, there was no mobilization and low carbohydrates which indicated that reserves were inadequate to support reproduction when photosynthesis was inhibited. This lack of reserves may explain high sensitivity of anthesis and early grain fill to low water potential. Decreasing sensitivity of grain development to low water potential as reproduction progresses may be due to increasing availability of reserves. (Michael-PTT)
W87-01109

RELATIONS AMONG RELATIVE LEAF WATER CONTENT, GROWTH, AND RUBBER ACCUMULATION IN GUAYULE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
W. L. Ehrler, D. A. Bucks, and F. S. Nakayama.
Crop Science CRPSAY, Vol. 25, No. 5, P 779-782, September-October 1985. 2 fig, 2 tab, 9 ref.

Descriptors: *Leaves, *Rubber, *Guayule, *Irrigation efficiency, *Crop yield, Soil moisture deficiency, Water shortage, Plant growth, Plant tissues, Irrigation requirements.

Relative leaf water content (RLWC) of guayule was measured to quantify the effect of soil water deficiency on plant growth and rubber yield. In the wet treatment, eight irrigations maintained adequate soil moisture for RLWC to stay near 80 percent at sampling time. In the dry treatment, soil water depletion reached almost 90 percent and two irrigations raised RLWC to only 70 percent for a brief time after which it decreased to a minimum of 35 to 40 percent. The dry treatment resulted in statistically significant decreases in height, dry weight and rubber and resin yields. The wet treatment produced more biomass and increased rubber and resin yields, but required much more irrigation

water. Further experimentation with different levels of RLWC is needed to develop an irrigation scheduling guide for efficient water use and good guayule rubber yields. (Michael-PTT)
W87-01110

EFFECT OF WATER STRESS ON CANOPY SENESCENCE AND CARBON EXCHANGE RATES IN COTTON,
Agricultural Research Service, Mississippi State, MS.
A. Marani, D. N. Baker, V. R. Reddy, and J. M. McKinion.
Crop Science CRPSAY, Vol. 25, No. 5, p 798-802, September-October 1985. 6 fig, 25 ref.

Descriptors: *Water stress, *Cotton, *Plant growth, *Plant tissues, *Carbon cycle, *Plant water potential, Leaves, Irrigation, Photosynthesis, Plant physiology.

The effect of water stress on the carbon exchange rate of cotton canopies and related parameters of plant growth and development was quantified. Treatments ranged from daily watering to an extra low treatment that was allowed to dry much faster than the low water treatment. Water stress had a strong effect on both plant growth and carbon exchange rates. Two different mechanisms are suggested for the effect of water stress on canopy photosynthesis. (Michael-PTT)
W87-01111

EVALUATION OF PEANUT GENOTYPES FOR RESISTANCE TO WATER STRESS IN SITU,
FMC Corp., Princeton, NJ.
For primary bibliographic entry see Field 3F.
W87-01112

DEVELOPMENT OF ACUTE FROST DROUGHT IN RHODODENDRON FERRUGINEUM AT THE ALPINE TIMBERLINE,
Innsbruck Univ. (Austria). Botanisches Inst.
W. Larcher, and R. Siegwolf.
Oecologia (Berlin), OECOBX, Vol. 67, No. 2, p 298-300, September 1985. 2 fig, 1 tab, 16 ref.

Descriptors: *Frost, *Drought, *Rhododendron, *Alpine regions, Snow, Melting, Shrubs, Photosynthesis, Water potentials, Plant water potentials, Respiration.

Acute winter frost drought in Rhododendron ferrugineum at the alpine timberline was provoked by removing the snow that had covered the shrubs and by irradiating and rewarming the twigs in situ in a climatized chamber simulating snow melt conditions. Water potential decreased to -2.3 MPa within three days. After activation of photosynthesis on the first day, the CO uptake decreased during the second day and approached zero at the third day. The internal CO concentration of the leaves increased with advanced dessication, indicating an impairment of chloroplast functions. The procedure of the disturbances appears to be similar to that of other acute drought events. (Author's abstract)
W87-01146

INFLUENCE OF RAIN, TIDAL WETTING AND RELATIVE HUMIDITY ON RELEASE OF CARBON DIOXIDE BY STANDING-DEAD SALT-MARSH PLANTS,
S. Y. Newell, R. D. Fallon, R. M. Rodriguez, and L. C. Groene.
Oecologia (Berlin), OECOBX, Vol. 68, No. 1, p 73-79, December 1985. 7 fig, 4 tab, 42 ref.

Descriptors: *Rain, *Tides, *Relative humidity, *Carbon dioxide, *Salt marshes, *Decomposing organic matter, Humidity, Marshes, Respiration, Spartina alterniflora, Juncus roemerianus.

Dead parts of salt-marsh plants form a considerable fraction of their annual average standing crop. A microbial assemblage living on and in the standing-dead leaves and stems of Spartina alterniflora and Juncus roemerianus responds to saltwater, freshwater, or water-vapor wetting by immediately beginning to release CO2 at steady rates of as much respectively, at temperature of 25-30 C, after an initial burst of higher rates. These CO2 release rates are within the range of maximal rates reported for decaying terrestrial litter, and are as high as most rates reported for S. alterniflora decaying under continuously wetted or submerged conditions. (Author's abstract)
W87-01147

RESPONSES OF AN AFRICAN TALL-GRASS (HYPARRHENIA FILIPENDULA STAPF.) TO DEFOLIATION AND LIMITATIONS OF WATER AND NITROGEN,
Syracuse Univ., NY. Biological Research Labs.
M. B. Coughenour, S. J. McNaughton, and L. L. Wallace.
Oecologia (Berlin), OECOBX, Vol. 68, No. 1, , p 80-86, December 1985. 2 fig, 4 tab, 24 ref.

Descriptors: *Hyparrhenia, *Grasses, *Water requirements, *Nitrogen, *Plant physiology, Growth, Photosynthesis, Biomass, Tanzania, Subhumid climates.

Hyparrhenia filipendula, a tall perennial grass common in dry-subhumid African savannas, was subjected to combinations of watering frequency, nitrogen supply, clipping height (10 and 15 cm), and clipping frequency (7 and 14 days). Biomass yield and allocation to various tissue types morphometric traits, and growth processes were measured. Watering frequency affected leaf elongation rate while nitrogen affected tiller number. Clipped yield was strongly correlated with leaf elongation rate but not tiller number, and therefore is primarily controlled by the activities of intercalary rather than apical meristems. There was a negative exponential relationship between tillering and clipped yield per tiller. The fraction of total net photosynthate allocated to roots was not significantly related to any environmental treatment. Root and crown growths were not affected by defoliation treatment; leaf blade and stem growths were inhibited; and sheaths were inhibited only under low water. Despite a tall stature; H. filipendula tolerates herbivory by increased photosynthetic rate, through continued production of young tissues by statistically constant proportional allocation to roots. Clipped yield increased only when both nitrogen and water were abundant, and then, proportional clipped yield did not surpass an upper asymptotic limit. (Author's abstract)
W87-01148

FURTHER INTERCEPTION STUDIES OF HEATHER USING A WET-SURFACE WEIGHING LYSIMETER SYSTEM,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W87-01197

STUDY OF THE EXCHANGE CAPACITIES AND OF CATION SELECTIVITY OF CELL-WALLS ISOLATED FROM THE ROOTS OF COCHLEARIA ANGLICA AND OF PHASEOLUS VULGARIS GROWN IN VARIOUSLY SALINE MEDIA, (ETUDE DES CAPACITES D'ECHANGE ET DES SELECTIVITES CATIONIQUES DE PAROIS ISOLEES DES RACINES DE COCHLEARIA ANGLICA ET DE PHASEOLUS VULGARIS CULTIVES SUR DES MILIEUX DIVERSEMENT SALES),
Caen Univ. (France). Lab. de Physiologie Vegetale.
J. Bigot, and P. Binet.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 5, p 955-958, May 1986. 2 tab, 23 ref.

Descriptors: *Cochlearia Anglica,*Phaseolus Vulgaris, *Cation exchange, *Salt tolerance, Glycophytes, Halophytes, Plant physiology, Cations.

Cochlearia anglica L. (halophyte) and Phaseolus vulgaris L. (glycophyte) were grown in media of different salinities. The root cell walls were isolated and then equilibrated with various salt solutions. There were differences between cell walls from C. anglica and P. vulgaris in both the cationic exchange capacity (computed by the sum of parietal cations) and the cell wall selectivity (evaluated by the centesimal proportion of each cation). In cell walls from plants grown without NaCl,the number of exchange sites was greater for the hallophyte than for the glycophyte. Growing the plants on 42 and 85 mM NaCl medium reduced or reversed the disparities between the two species: with C. anglica the cell wall cationic exchange capacity decreased when the growth medium salinity increased whereas this capacity tended to rise for P. vulgaris. However, the culture medium salinity did not affect the cell wall selectivity of these species for major cations. For Ca(2+), the selectivity of cell walls from P. vulgaris was higher than that of cell walls from C. anglica; for the other cations, the situation was reversed. (Author's abstract)
W87-01327

EFFECT OF DROUGHT ON THE LIPID FRACTION DURING WILTING IN THE CUT CARNATION (DIANTHUS CARYOPHYLLUS L. CV. EMBER), (INFLUENCE DES CONTRAINTES HYDRIQUES SUR L'EVOLUTION DES LIPIDES AU COURS DE LA SENESCENCE DE L'OEILLET COUPE (DIANTHUS CARYOPHYLLUS L. CV. EMBER)),
Laboratoire de Physiologie des Organes Vegetaux apres Recolte, Meudon-Bellevue (France).
A. Paulin, and C. Vanneste.
Comptes Rendus de l'Academie des Sciences (Series 3) CHDDAT, Vol. 302, No. 5, p 157-160, February 7, 1986. 2 fig, 1 tab, 10 ref.

Descriptors: *Plant physiology, *Water stress, Membrane Lipids, Fatty acids, Peroxidation, Wilting, Carnations, Dianthus, Free Radicals.

Water stress (43 and 50 hours without water at 23 C) caused, after return to normal conditions, an accelerated wilting. This reduced vase-life was associated with a loss of fatty acids from polar lipids, in particular of the unsaturated fatty acids (linoleic and oleic). It is suspected that free radicals may be the agent involved, since they are implicated in loss of membrane integrity. Further experiments will seek to verify this hypothesis. (Airone-PTT)
W87-01341

INFLUENCE OF DIFFERENT IRRIGATION METHODS AND INTERVALS ON THE INFESTATION OF VIGNA UNGUICULATA SSP. CYLINDRICA BY UROMYCES SPP. UNDER ARID CONDITIONS, (EINFLUSS UNTERSCHIEDLICHER BEWAESSERUNGSVERFAHREN UND -INTERVALLE AUF DEN BEFALL VON VIGNA UNGUICULATA SSP. CYLINDRICA DURCH UROMYCES SPP. UNTER ARIDEN BEDINGUNGEN),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Oekologie.
G. Wessolek, and U. Meier.
Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz, Vol. 92, No. 6, p 594-599, December 1985. 1 fig, 2 tab, 16 ref.

Descriptors: *Irrigation, *Plant pathology, *Arid zones, *Uromyces, *Vigna unguiculata, Desert grass, Microclimates, Agriculture, Drip irrigation, Sprinklers, Furrow irrigation.

The influence of different irrigation methods (drip, sprinkler, furrow) on the infestation of Vigna unguiculata ssp. cylindrica with Uromyces spp. was tested under arid conditions. The results, based on evaluation of natural leaf infestation, demonstrated that (1) the use of sprinkler systems, especially medium pressure sprinklers, caused a significantly higher infestation than did drip or furrow - significant differences between the latter two methods could not be observed; (2) generally, short intervals (1-2 days) produced a higher infestation with Uromyces than did long irrigation intervals (3-4 days), and this increase is greater in sprinkler than in drip irrigation. The different leaf infections could be attributed to a change in the microclimatic and epidemiological conditions as well as in an altered predisposition of the host plants. (Author's abstract)
W87-01349

ECOLOGICAL INTERACTIONS BETWEEN THE ALLUVIAL FORESTS AND HYDROLOGY OF THE UPPER RHONE,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
G. Pautou, and H. Decamps.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 1, p 13-37, July 1985. 4 fig, 5 tab, 42 ref.

Descriptors: *Alluvial forests, *Rhone River, *Ecosystems, *Water tables, Ecology, Hydrology, Geneva, Lyon, France, Switzerland, Soil water, Soil aeration, Hydrologic models.

The alluvial forest of the Upper Rhone corridor situated between Geneva and Lyon, covering more than 10,000 hectares, comprises a complicated mosaic of interdependent plant communities. In an essentially heterogeneous space, the distribution of these communities depends on water flow and their influence on soil characteristics. The diversity of hydrological sites considerably complicates the analysis of the role played by the water-table in providing the vegetation of alluvial forests with water. Based on observations collected over a period of fifteen years, a table of the main sequences in relation to various soil types and depths of water-tables is proposed. Due to their frequent and regular fluctuations, water tables sustain the spatial organization of plant communities. For the entire ecosystem studied, biomass increases along with the depth of water table, soil aeration and silt enrichment, ranging from Salix spp. thrusts (30 to 50 t D.W./ha) to hardwood forests (350 to 400 t D.W./ha). Because of its high productivity, the littoral vegetation constitutes the basis for various aquatic and terrestrial trophic networks. Successions of the allogenic and autogenic types interpenetrate each other and alternatively dominate according to their remoteness from the Rhone. A few consequences of earthworks on the vegetation of the flood plain are predictable from such features as the location, composition and extension of the plant communities. The Rhone model seems to be applicable to other European valleys. (Lantz-PTT)
W87-01479

ECOLOGICAL DIFFERENCES IN THE DEVELOPMENT OF THREE BIOGEOCENOSES IN THE TIGROVAYA BALKA RESERVE,
Akademiya Nauk Tadzhikskoi SSR, Dushanbe.
S. P. Lomov, M. Y. Medvedev, and A. A. Konnov.
Soviet Journal of Ecology SJECAH, Vol. 16, No. 2, p 85-90, March/April 1985. 4 fig, 1 tab, 6 ref. Translated from Ekologiya, No. 2, p 30-37, March-April 1985.

Descriptors: *Ecology, *Biogeocenoses, *Tigrovaya Balka Reserve, *Geochemistry, *Soil-water-plant relationships, Soil water, Seasonal variation, Wilting point, Plant populations, Populations, Roots, Shrubs, Desert plants, Moisture deficiency, Soil moisture deficiency.

The ecological differences in the formation of biogeocenoses in Tigrovaya Balka Reserve are due to autonomous or geochemically subordinate conditions of landscape development. The autonomous conditions of development are due only to atmospheric moistening with seasonal character of biogeocenose development, creating a unique phytocenose spectrum. Intrazonal geochemically subordinate biogeocenoses with supplemental ground moisture are distinguished by the absence of developmental seasonality, the supplemental entry of geochemical components due to their introduction from other biogeocenoses with the groundwaters, and by a high productivity compared with zonal analogues. The ecological differences in the formation of zonal biogeocenoses are due to specific soil properties retained from past stages of biosphere development. These properties determine the high magnitude of the maximum hygroscopicity and accordingly the wilting moisture, which appreciably lower the volume of the accessible moisture and the productivity of the foregoing biogeocenoses. The characteristics of the structure and property of reserve soils determine the differences in the distribution of the root system of the major shrubby dominants, thus indicating the high adaptive capacity of desert plants to the distribution and deficit of moisture. (Doria-PTT)
W87-01579

CHANGES IN CUTICULAR TRANSPIRATION RATE AND CUTICULAR LIPIDS OF OAT (AVENA SATIVA) SEEDLINGS INDUCED BY WATER STRESS,
Goeteborg Univ. (Sweden). Dept. of Botany.
M. Svenningsson, and C. Liljenberg.
Physiologia Plantarum PHPLAI, Vol. 66, No. 1, p 9-14, January 1986. 6 fig, 1 tab, 13 ref.

Descriptors: *Transpiration, *Lipids, *Oats, *Seedlings, *Water stress, Alkanes, Fatty acids, Alcohols, Molecular structure, Plant physiology.

Two cultivars of oat were exposed to short periods of water-deficit stress on five consecutive days. After two stress periods the cuticular transpiration rate was reduced by 30% for cultivar Pendek and by 47% for cultivar Stormogul II, and after another three stress periods by 30% and 20%, respectively. These reductions were correlated neither with changes in any of the so-called epicuticular lipids, nor with any of the major individual constituents of epicuticular lipids (alkanes, free and esterified fatty acids, or free primary alcohols). After removal of the epicuticular lipids, the long chain free primary alcohols of the leaves were extracted and determined. The amount of these, presumably intracuticular, alcohols increased after stress and changed to shorter chain length. From these results it is concluded that the intra- as well as the epicuticular lipids must be considered when discussing leaf surface lipids as protective agents against water loss. (Author's abstract)
W87-01638

EFFECTS OF FAR-RED LIGHT ON MALATE AND POTASSIUM CONTENTS IN COTTON LEAVES: RELATION TO DROUGHT RESISTANCE,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Inst. de Physiologie Vegetale.
C. Hubac, D. Guerrier, and U. Bousquet.
Physiologia Plantarum PHPLAI, Vol. 66, No. 1, p 37-40, January 1986. 2 tab, 19 ref.

Descriptors: *Potassium, *Malate, *Cotton, *Drought resistance, *Far-red light, *Transpiration, Plant physiology, Calcium.

Long- or short-term far-red light given before a dark treatment modified the water status and potassium and malate contents in cotton leaves. Upon a long-term treatment, the leaf water content and the leaf water and osmotic potentials were lower, whereas stomatal resistance was greater with a decrease in daily transpiration. There was a parallel increase in potassium and malate, but the calcium content was not significantly changed. This resulted in better water economy with an increase in drought resistance. Upon a short-term treatment, the accumulation of potassium and malate was reversible and the drought resistance was modified accordingly. There was a positive correlation between the ability of a plant to resist water stress and the content of potassium and malate. (Author's abstract)
W87-01639

SOME PHYSIOLOGICAL AND GROWTH RESPONSES OF KIWI FRUIT (ACTINIDIA CHINENSIS) TO FLOODING,
Carretera de Cabrils s/n, Barcelona (Spain). Unitat de Tecnologia i Agroenergetica.
R. Save, and L. Serrano.
Physiologia Plantarum PHPLAI, Vol. 66, No. 1, p 75-78, January 1986. 3 fig, 2 tab, 24 ref.

Descriptors: *Kiwi fruit, *Flooding, *Plant growth, *TRanspiration, *Stomato, Chlorosis, Necrosis, Plant Physiology, Plant pathology, Plant water potential, Osmosis.

The effects of long-term flooding on the growth of 6-month-old Actinidia chinensis Planch cv. Abbot plants and some effects on stomatal behavior and leaf water relations were examined under controlled conditions for 28 days. Flooding caused stomatal closure and decreases in transpiration rate, xylem water potential, osmotic potential, and turgor potential. Flooding also caused inhibition of the dry weight increase of leaves plus stems and of roots, chlorosis and necrosis of leaves, production of hypertrophied lenticels and the appearance of a small number of adventitious roots on the submerged portions of the stems. Rapid and partial stomatal closure by flooding may not only be due to the passive mechanical response that follows leaf dehydration, since flooded plants showed an increase in xylem water potential and osmotic potential during the first days of the experiment. (Author's abstract)
W87-01640

2J. Erosion and Sedimentation

ORIGIN AND NATURE OF SELECTED INORGANIC CONSTITUENTS IN NATURAL WATERS,
University of Southern California, Los Angeles. Environmental Engineering Program.
For primary bibliographic entry see Field 2K.
W87-00914

ATCHAFALAYA RIVER DELTA, REPORT 7: ANALYTICAL ANALYSIS OF THE DEVELOPMENT OF THE ATCHAFALAYA RIVER DELTA,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
F. C. Wang.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA164931, A10 in paper copy, A01 in microfiche. Technical Report No. HL-82-15, September 1985. 199 p, 36 fig, 10 tab, 17 plates, 63 ref, 5 append. Contract No. DACW39-81-C-0004.

Descriptors: *Sediment transport, *Mississippi River Basin, *Deltas, *Hydrodynamics, *Sedimentation, Rivers, Atchafalaya River, Louisiana, Flow, Bays, Turbulent flow, Mathematical studies, Mississippi River, Wetlands, Marshes, Deposition.

The diversion of fresh water and sediments from the Mississippi River to the Atchafalaya River is developing a new delta on the south-central Louisiana coast. This study reports the analytical prediction of future delta growth based on the theory of turbulent jets that issue from river outlets and discharge into quiescent bays. Results show that the deposited sediment forms a saddle-shaped bottom. Rapid accumulation of suspended sediment near the river outlet and an abrupt decline of sediment deposition away from the outlet are observed. It is concluded that the riverine inflow has a significant influence of sediment deposition within a short longitudinal distance, and that beyond that distance the riverine inflow is insignificant. (Cassar-PTT)
W87-00942

STUDY OF THE RELATIONSHIP BETWEEN WATER QUALITY AND SEDIMENT TRANSPORT: A GUIDE FOR THE COLLECTION AND INTERPRETATION OF SEDIMENT QUALITY DATA,
H. L. Golterman, P. G. Sly, and R. l. Thomas.
Available from UNIPUB, P. O. Box 1222, Ann Arbor, MI. 48106 as 4072-U1362, UNESCO Technical Papers in Hydrology 26, 1983. 231 p, 70 fig, 47 tab, 294 ref.

Descriptors: *Data acquisition, *Pollutant identification, *Sediments, Sampling, Water quality, Particle size, Organic matter, Sorption, Chemical precipitation, Salinity, Leaching, Oxygen, Minerals, Seasonal variation, Lake sediments, Bottom sediments, Fluvial sediments, Rivers, Suspended sediments, Fate of pollutants, Nutrients, Bioaccumulation, Organic compounds, Chemical analysis.

This guidebook is intended to help in the design, sampling, analysis, and interpretation of sediment studies in rivers, streams, lakes, ponds, and estu-

aries. It shows the influence of sediment composition upon water quality and the influence of water quality upon sediments. The main subject classifications are nature and properties of sediments, sediment sampling programs, sampling equipment and analytical methods, data processing, sediment dating, contaminants, and three types of case histories, each with several examples: dispersion of contaminants and changes with time, major and trace elements and anthropogenic organic compounds, and nutrient contaminants. (Casser-PTT)
W87-00948

EROSION AND SUSPENDED SEDIMENT TRANSPORT IN AN AGRICULTURAL BASIN. METHOD OF MEASUREMENT OF THE SURFACE RUNOFF, OF ITS SUSPENDED LOAD AND OF THE TWO COMPONENTS OF THE PARTICULATE TRANSPORT IN A RIVER (EROSION ET TRANSPORT DE MATIERES EN SUSPENSION DANS UN BASSIN VERSANT EN REGION AGRICOLE. METHODE DE MESURE DU RUISSELLEMENT SUPERFICIEL, DE SA CHARGE ET DES DEUX COMPOSANTES DU TRANSPORT SOLIDE DANS UN COURS D'EAU),
Toulouse-3 Univ. (France). Lab. de Mineralogie et Cristallographie.
D. Etchanchu, and J.-L. Probst.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 302, No. 17, p 1063-1068, May 17, 1986. 4 fig, 19 ref.

Descriptors: *Channel erosion, *Suspended sediments, *Agricultural runoff, *Girou River, France, Fluvial sediments.

A method is proposed for calculation of the contributions of channel erosion and slope erosion to the fluvial transport of suspended sediments by the Girou River (southwestern France). The surface runoff was determined using the separation of the streamflow components on the stream hydrograph. During the water year 1983-84, the surface runoff represents only 8% of the total river flow. About 70% of the river suspended load is produced by slope erosion, whereas channel erosion represents 30%. After correction for channel erosion and by using two different methods of calculation, the suspended sediment concentration of the surface runoff is estimated at 1 g/liter. (Author's abstract)
W87-01096

SEDIMENT TRANSFER TO OVERBANK SECTIONS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
C. S. James.
Journal of Hydraulic Research, Vol. 23, No. 5, p 435-452, 1985. 3 fig, 5 tab, 16 ref.

Descriptors: *Sedimentation, *Mathematical models, *Suspended sediments, *Channels, *Flood plains, *Flow pattern, *Flow velocity, *Diffusivity, *Shear stress, *Deposition, Mathematical equations, Convection, Turbulent flow, Sedimentation, Sedimentation rates, Bed load, Sand.

A numerical model for simulating the transfer of suspended sediment from a channel to an adjacent floodplain under steady, longitudinal uniform flow conditions is presented. The model considers transverse transfer of sediment by convection and turbulence. Turbulent transfer is modelled by diffusion analogy and empirical relationships are used to evaluate the distributions of diffusivity and bed shear stress. The equations describing suspended sediment concentrations under the influence of these transfer mechanisms is solved numerically using the Successive Over-Relaxation Method. The model can be applied to sediments of different sizes and densities and can be used to predict distribution of deposits over floodplains and the size and density characteristics of deposited material. The model is verified by comparing predicted distributions of fine sand deposits with those measured in laboratory experiments for extreme plain surface conditions. (Author's abstract)
W87-01114

PERMANENCE OF DEBRIS DAMS RELATED TO RIVER CHANNEL PROCESSES,
Southampton Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W87-01115

SEDIMENT AND NUTRIENT DISCHARGE THROUGH STREAMFLOW FROM TWO EXPERIMENTAL WATERSHEDS IN MATURE OAK-BEECH FOREST ECOSYSTEMS NEAR ISTANBUL, TURKEY,
Istanbul Univ. (Turkey). Faculty of Forestry.
For primary bibliographic entry see Field 5B.
W87-01179

STUDY ON SYNTHETIC SEDIMENTGRAPHS FOR UNGAGED WATERSHEDS,
Transviron, Inc., Lutherville, MD.
V. J. Chen, and C. Y. Kuo.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 35-54, April 15, 1986. 9 fig, 5 tab, 15 ref.

Descriptors: *Sediment yield, *Path of pollutants, *Erosion, Model studies, Sedimentgraphs, Hydrographs, Watershed management, Hydrology, Mathematical studies.

A new rigorous synthetic procedure to generate unit sedimentgraphs for ungaged watersheds has been developed. The model is based on a one-hour unit sedimentgraph which is defined as the direct sedimentgraph resulting from one unit of effective sediment yield of a storm of one-hour duration generated uniformly over the basin at a uniform rate. Thus, the one-hour sedimentgraph of a storm for a specific watershed can be generated by convolving the one-hour unit sedimentgraph with the effective sediment erosion of one hour duration provided that the rainfall record and characteristics of soil and watershed are known. Results of both spatial and temporal verification of the developed model show that agreements between the synthetic and actual sedimentgraphs are fairly good. (Author's abstract)
W87-01263

FORMATION OF AN EROSION PIT IN A STILLING BASIN: A CONSEQUENCE OF CAVITATION, (LA FORMATION D'UNE FOSSE D'EROSION DANS UN BASSIN DE DISSIPATION: UNE CONSEQUENCE DE LA CAVITATION),
Coyne et Bellier, Paris (France).
E. Frossard.
La Houille Blanche, No. 6/7, p 511-517, 1985. 6 fig, 13 ref.

Descriptors: *Erosion, *Cavitation, *Fluid mechanics, *Hydraulic models, Turbulent flow, Hydraulic jump, Veronese equation, Mathematical equations, Energy Dissipation, Momentum.

An erosion pit may form in a basin into which a hydraulic jump falls freely. A simple, semiquantitative physical model of describes the pressure effects at the bottom of the basin, resulting from three components: static pressure (tailwater rating-curve), average dynamic overpressure (impact of a stationary jump), and fluctuation around the mean value (turbulence). From the characteristics of the mean and fluctuating pressures taken from the literature, the model analytically gives the minimum depth eliminating the risk of cavitation on the bottom. Formally, and as an order of magnitude, this depth corresponds to the ultimate erosion depth given by Veronese's conventional empirical expression. As the physical motor of this mechanism is the effect of momentum, the role of energy dissipation is discussed. (Author's abstract)
W87-01328

TRANSIENT CHARACTER OF A TURBIDITY CURRENT IN A RESERVOIR,
For primary bibliographic entry see Field 8B.
W87-01360

DEFORMATION OF RIVER CHANNELS IN THE DAM STRETCH,
For primary bibliographic entry see Field 8B.
W87-01370

CANALS IN COHESIVE SOILS,
For primary bibliographic entry see Field 8B.
W87-01390

SOME PRESSING PROBLEMS OF CANAL HYDRAULICS,
For primary bibliographic entry see Field 8B.
W87-01395

SORTING OF BED LOAD SEDIMENT BY FLOW IN MEANDER BENDS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, and E. D. Andrews.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1361-1373, September 1985. 11 fig, 30 ref, append. NSF Grant CEE 8311721 and CEE 8204953; EPA Grant R808683-01.

Descriptors: *Bed load, *Sediments, *Flow, *Meanders, *Sediment sorting, Streams, Streamflow, Model studies, Sediment load, Sediment transport.

Equilibrium sorting of bed load sediment in meander bends is described analytically. The model is based on a relation between transverse and downchannel bed load transport, involving the inward transverse pull on bed load grains due to secondary currents, and the lateral downslope pull on bed load grains due to gravity. This theory is coupled with a simple treatment of flow in bends, an analytically determined bend shape, and the condition of continuity of each grain size range in transport to describe sorting. The sorting process is initiated at the upstream inflection point of a bend and terminates at the downstream inflection point. The theory indicates that the locus of coarse material moves constantly outward as the bend is traversed in the downstream direction. For periodic bends, the locus of coarse material crosses from the inside to the outside at a point where the downchannel centerline direction is parallel to the valley direction; this is typically at or near the bend apex. This compares well with observed results. (Doria-PTT)
W87-01530

ESTIMATING TOTAL SUSPENDED SEDIMENT YIELD WITH PROBABILITY SAMPLING,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. B. Thomas.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1381-1388, September 1985. 2 fig, 1 tab, 17 ref.

Descriptors: *Suspended sediments, *Estimating, *Probability sampling, *Sediment yield, *Sampling, *SALT method, Mathematical studies, Sediment discharge, Flow.

The Selection At List Time (SALT) technique for sampling sediment with probability proportional to the magnitude of estimated sediment transport uses a sediment rating function to calculate an auxiliary variable that directs the sampling process. The auxiliary variable is an estimate of the suspended sediment yield during a short time period (sample unit) and must be calculated for every unit in the population. Sampling efficiency is improved because the probability of taking a sample is proportional to the estimated contribution of that unit to the total yield. This procedure gives unbiased estimates of total suspended sediment yield and the variance of the estimate while automatically emphasizing sampling at higher flows. When applied to real data with known yield, the SALT method underestimated total suspended sediment yield by less than 1%, whereas estimates by the flow duration sediment rating curve method averaged about 51% underestimation. The SALT scheme requires obtaining samples with a pumping sampler, stage sensing device, and small battery-powered computer. (Doria-PTT)
W87-01532

EFFECTS OF SUSPENDED SEDIMENT ON THE OPEN-CHANNEL VELOCITY DISTRIBUTION,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
N. L. Coleman.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1377-1384, September 1986. 9 fig, 2 tab, 10 ref.

Descriptors: *Sediment transport, *Geomorphology, *Suspended sediment, *Open channels, *Channel flow, *Flow velocity, Mathematical analysis, Mathematical equations, Hydraulic properties.

Experiments were performed in which suspended sediment concentration in open-channel bounded shear flow was varied systematically while flow depth, slope, and discharge were held essentially constant. The effect of variation in suspended sediment concentration on velocity profile characteristics was investigated. The wake region functions for clear-water control profiles were equally applicable to profiles in sediment-suspending flows, indicating that the wake strength coefficient II, and not the wake region function itself, is affected by the presence of suspended sediment. The thickness of the inertial (logarithmic) region was relatively smaller in sediment-suspending flow than in comparable clear-water flows. The Karman coefficient remained essentially constant over a range of Richardson numbers from zero (clear water) to about 100 (capacity sediment suspension). The wake strength coefficient varied from a clear-water asymptote of about 0.2 to a capacity suspension asymptote of about 0.9. The function was universal for the three particle sizes used in the experiments. In classical law of the wall coordinates, the logarithmic parts of velocity profiles in sediment-suspending flow were shifted downward relative to control profiles in comparable clear-water flows. (Lantz-PTT)
W87-01587

SEDIMENT TRANSPORT CAPACITY OF SHEET AND RILL FLOW: APPLICATION OF UNIT STREAM POWER THEORY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
I. D. Moore, and G. J. Burch.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1350-1360, August 1986. 11 fig, 2 tab, 37 ref.

Descriptors: *Sediment transport, *Laminar flow, *Rill flow, *Unit Stream Power Theory, *Mathematical analysis, Clays, Slope, Overland flow, Aggregates, Flow rates, Mathematical studies.

Theoretical equations for calculating the unit stream power of both sheet and rill flow were developed and used to predict the sediment transport capacity of such flows. Independent data sets from three sources representing both finely aggregated clay soils and coarse textured nonaggregated soils, sheet, rill, and composite sheet rill flow systems, and a range of slopes were used to test the utility of the method. The results were very good and demonstrated the simplicity and robustness of the method. For shallow overland flow the best results were obtained when the critical unit stream power at incipient sediment motion was treated as a constant value that was independent of slope. The results also suggest that a unique value of critical unit stream power for rill initiation exists that is independent of soil type. For noncohesive loams or fine sands and finely aggregated clay soils, the sediment transport capacity can be accurately predicted from a knowledge of the physical characteristics of the soil or bed material alone. For aggregated clay soils this requires information on the aggregate size distribution and the effects of soil particle size differentiation as flow rates and unit stream powers increase with the transition from sheet to rill flow. (Author's abstract)
W87-01637

INFLUENCE OF DRAINAGE AREA FACTORS ON THE WATER QUALITY OF SMALL LAKES IN THE KOUTAJOKI RIVER BASIN WITH SPECIAL REFERENCE TO METALS,
Water District Office of Oulu (Finland).
For primary bibliographic entry see Field 2H.
W87-01741

STEADY-STATE MODEL FOR TWO HUMIC FRACTIONS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2H.
W87-01754

MISSISSIPPI RIVER PASSES PHYSICAL MODEL STUDY: REPORT 2, SHOALING AND HYDRAULIC INVESTIGATIONS IN SOUTHWEST PASS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W87-01759

MORPHOLOGIC EFFECTS OF LOWER MISSISSIPPI RIVER DIKE FIELDS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
N. R. Nunnally, and L. B. Beverly.
Available from the National Technical Information Service, Springfield, VA. 22161. Miscellaneous Paper E-86-2, May 1986. Final Report. 72 p, 5 fig, 9 tab, 20 ref, append. Contract No. DACW83-M-1287.

Descriptors: *Channel morphology, *Mississippi River, *Dikes, Aerial photography, Surveys, Channels, River flow, River mechanics, Sloughs, Chutes, Pools.

Low-water photographs taken in 1962 and 1976 and comprehensive hydrographic surveys done in 1962-64 and 1974-75 were used to measure morphologic changes in diked and undiked reaches of the lower Mississippi River. River surface area between river miles 320 and 954 was classified as main channel, secondary channel, slough, chute, or pool. The 1962 and 1976 areas in each category were measured from the photographs. River stage at the time of photography averaged about 2 ft (0.6 m) lower in 1976, so 1976 measurements were adjusted for stage differential, based on width measurements taken from the hydrographic surveys. Results were summarized for diked and undiked reaches. Total river area remained relatively constant. Secondary channel area decreased by 16.28 sq mi (42.2 sq km) (-38.6%), but this was offset by increased in sloughs, chutes, and pools. Sloughs increased by 7.13 sq mi (18.5 sq km) (+53.2%), chutes by 6.92 sq mi (17.9 sq km) (+44.8%), and pools by 5.09 sq mi (13.2 sq km) (+2,357.1%). Practically all of the loss occurred in secondary channel area, and all of the increase in sloughs, chutes, and pools occurred in diked reaches. Analysis of changes by age of dike field revealed no noticeable trends or patterns. (Lantz-PTT)
W87-01760

2K. Chemical Processes

EVALUATION OF THE VALIDITY AND STATISTICAL VARIABILITY OF LITHIUM AND FLUORIDE DISTRIBUTION COEFFICIENT VALUES IN A COMPLEX GEOCHEMICAL SYSTEM,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
H. F. Pavlik, and D. D. Runnells.
DOE Research Highlight Report DOE/ER-0261, January 1986. 16 p, 2 fig, 5 tab, 7 ref.

Descriptors: *Statistical analysis, *Lithium, *Fluoride, *Distribution coefficients, *Geochemistry, Path of pollutants, Mathematical analysis, Adsorption, Analysis of variance, Piceance Creek, Colorado.

This research presents a statistical evaluation of the validity of the distribution coefficient (Kd) to describe adsorption of lithium and fluoride in a complex, natural rock-fluid system. The general goal of the research was to generate Kd parameters appropriate for simulating contaminant migration from oil shale waste disposal sites planned for the Piceance Creek Basin of western Colorado. Specific objectives were to: (1) Test the key assumptions that control valid application of the Kd in any rock-fluid system. Included among these are the assumptions that the slope of the partitioning function is constant and linear, that the choice of solid/solution ratio used in laboratory batch studies has no effect on the Kd determination, and that the Kd value is independent of concentration; and, (2) Determine the statistical variability of Kd values for lithium and fluoride obtained in the laboratory and hence provide a confidence interval for Kd values for this rock-fluid system. Linear regression analyses of adsorption isotherm (S-C) data showed that the partitioning function between sorbate and adsorbent is linear under the range of concentrations chosen for the lithium and fluoride experiments. The validity of linear adsorption models for both lithium and fluoride indicate that concentration effects have negligible impact on Kd values in this rock-fluid system. However, Kd values for fluoride are approximately twice as large as those for lithium. Evaluation of adsorption isotherm data reveal that despite major differences in geochemical behavior, sorption of lithium and fluoride is subject to remarkably similar trends in variance in this rock-fluid system. Variance of sorbed solute increases from solid/ solution ratio 1:2 to 1:20 and the slope (Kd) of the S-C function is relatively constant from ratio to ratio. Analysis of covariance results indicate that the choice of solid/solution ratio has no statistically significant effect on the Kd determination. However, high mass-to-fluid ratios generate Kd values that have lower variance and greater reproducibility than low mass to fluid ratios. (Lantz-PTT)
W87-00874

ANAEROBIC BIOGEOCHEMICAL PROCESSES IN THE SUBSURFACE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W87-00884

HYDROPHYSICAL INTERACTIONS OF ORGANIC CHEMICALS WITH GEOLOGICAL MATERIALS: REVIEW OF INTERACTIONS OF ORGANIC CHEMICALS IN THE SUBSURFACE WITH EMPHASIS ON CLAYS AND LOW PERMEABILITY SEDIMENTARY ROCKS.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W87-00885

THRESHOLDS FOR ACIDIFICATION: A FRAMEWORK FOR POLICY AND RESEARCH,
Environmental Defense Fund, New York.
For primary bibliographic entry see Field 5B.
W87-00890

FIRST CANADIAN/AMERICAN CONFERENCE ON HYDROGEOLOGY: PRACTICAL APPLICATIONS OF GROUND WATER GEOCHEMISTRY.
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 2F.
W87-00892

ROLE OF REGIONAL GRAVITY FLOW IN THE CHEMICAL AND THERMAL EVOLUTION OF GROUND WATER,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W87-00893

OCCURRENCE OF DISSOLVED OXYGEN AND THE ORIGIN OF FERRIC HYDROXIDE-CEMENTED HARDBEDS IN THE PATUXENT AQUIFER, MARYLAND,

Geological Survey, Towson, MD. Water Resources Div.
F. H. Chapelle.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 41-46, 4 fig, 11 ref.

Descriptors: *Groundwater geochemistry, *Diagenesis, *Dissolved oxygen, *Ferric hydroxide, *Hardbeds, *Patuxent Aquifer, *Maryland, Water quality, Groundwater movement, Sulfates, Groundwater recharge.

The outcrop area of the Patuxent Aquifer (Lower Cretaceous) in Maryland exhibits lenses of ferric hydroxide-cemented sandstones and conglomerates. In this paper, it is proposed that the observed cementation is post-depositional in origin and has resulted from the reaction of groundwater with aquifer materials. The chemical composition of water in the Patuxent Aquifer changes systematically as it flows down the hydrologic gradient. In the outcrop-recharge area, Patuxent water contains high concentrations of dissolved oxygen (5-10 mg/l), low concentrations of dissolved iron (0.01-0.1 mg/l) and sulfate (1.0-2.0 mg/l), and a relatively low pH (4.5-5.5 pH units). Much of the groundwater entering the aquifer in the outcrop area is subsequently discharged to perennial streams. About 1 inch/year (2.5 cm/yr) of recharge, however, enters the confined part of the aquifer system and flows downgradient. As this water flows downgradient, dissolved oxygen (O2) concentrations decrease and dissolved sulfate concentrations increase in a molar ratio of about 3-to-1. These changes occur as pyrite and lignite, which are important lithologic constituents of the Patuxent, and are oxidized. As a result of these processes, ferric hydroxide is precipitated as dissolved oxygen and is consumed. Because the atmosphere is the only source of dissolved oxygen to Patuxent Aquifer water, the occurrence of ferric hydroxide cementation is restricted to within about 2 mi (3.2 km) of the outcrop-recharge area. (See also W87-00892) (Author's abstract)
W87-00894

HYDROCHEMICAL PROCESSES IN THE REGIONAL GROUND WATER DISCHARGE ZONES OF THE MURRAY BASIN, SOUTHEASTERN AUSTRALIA,
Victoria Dept. of Minerals and Energy, Melbourne (Australia).
For primary bibliographic entry see Field 2F.
W87-00895

CHEMICAL EQUILIBRIUM AND KINETICS OF GEOCHEMICAL PROCESSES IN GROUND WATER STUDIES,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 2F.
W87-00896

SOLUBILITY CONTROLS OF FLUORINE, BARIUM AND CHROMIUM IN GROUND WATER IN ALLUVIAL BASINS OF ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-00897

GEOCHEMICAL MODELS OF THE RELATION BETWEEN WATER QUALITY AND MINERALOGY IN COAL-PRODUCING STRATA OF SOUTHWESTERN VIRGINIA,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-00898

GEOCHEMICAL MODELING: A COMPARISON OF FORWARD AND INVERSE METHODS,
Geological Survey, Reston, VA.
L. N. Plummer.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 149-177, 16 fig, 4 tab, 67 ref.

Descriptors: *Groundwater geochemistry, *Geochemistry, *Model studies, *Groundwater, Minerals, Groundwater movement, Groundwater quality, Mass transfer, Thermodynamics, Flow pattern.

This paper discusses methods for learning quantitative details of the evolutionary reaction path of water and rock along recognized or hypothetical flow lines in groundwater systems. The goals are: (1) to identify those minerals that are recognized flow line, (2) to determine the regional variation in the number of moles of each mineral entering or leaving the groundwater, and (3) to predict water quality and mass transfer in systems yet unstudied. Various concepts of geochemical modeling are reviewed and compared as they apply to the inverse problem and the forward problem. The inverse problem attempts to find a set of net mass transfer reactions that are thermodynamically feasible and satisfy the mass balance criteria using the available hydrochemical data. The forward problem involves a priori prediction of water composition and reaction path in hypothetical systems. The forward problem has the advantage of predicting details of thermodynamically valid reaction paths between the initial and final points, provided each path is constrained by the net mass transfer derived from the inverse problem. While defining the net mass transfer along the flow line, the inverse problem in not directly constrained by thermodynamics and results should be checked by the forward problem, or at least partially through thermodynamic speciation calculations at the initial and final points in the system. (See also W87-00892) (Lantz-PTT)
W87-00901

EXPECTED BRINE CHEMISTRY IN A NUCLEAR WASTE REPOSITORY IN SALT,
Weston Consultants, Rockville, MD.
For primary bibliographic entry see Field 5C.
W87-00904

INTERACTIONS OF ACIDIC SOLUTIONS WITH SEDIMENTS: A CASE STUDY,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W87-00905

GRAPHICAL AND STATISTICAL TREATMENT OF STANDARD FORMATION WATER ANALYSES,
Geological Survey of Canada, Calgary (Alberta).
B. Hitchon.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 225-236, 16 fig, 2 tab, 12 ref.

Descriptors: *Statistical analysis, *Graphical analysis, *Formation water, *Geochemistry, Water analysis, Multivariate analysis, Statistical methods, Factor analysis.

The main objective of all graphical and statistical techniques for evaluating formation water analyses is to obtain information which is not readily apparent from the analyses. The specific treatment technique depends, to a great extent, on the nature of the required information and the size of the data base. Four multivariate statistical methods are applied to the same data set and comparisons made between the results obtained. Factor analysis is probably the most powerful, and intrinsically provides the most information, allowing the identification of populations by Q-mode analysis and of fundamental geochemical relations by R-mode analysis. Both discriminant analysis and cluster analysis can be used to identify populations, the advantage of the former being the determination of the major discriminators in pre-selected provisional populations and of the latter the statistical selection of populations with a priori knowledge. Because many geochemical data are lognormally distributed, and extreme outliers may exert undue influence in discriminant (and especially cluster) analysis, multi-response permutation procedures (MRPP) are particularly important in confirming the efficacy of the discriminant analysis because there is no underlying distributional assumption about the data set. Future directions in statistical applications to formation water analyses include linking multivariate statistical techniques to the results of solution-mineral relation studies, trend surface maps of a combination of statistical/solution-mineral results, and steady-state and transient models of heat-chemical-mass transport. (See also W87-00892) (Lantz-PTT)
W87-00906

MULTIVARIATE STATISTICAL ANALYSIS AND CHEMICAL MASS BALANCE ANALYSIS OF WATERS OF THE COPPER RIVER BASIN, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. B. Hawkins, and R. J. Motyka.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 238-245, 2 fig, 5 tab, 24 ref.

Descriptors: *Multivariate analysis, *Chemical analysis, *Copper River basin, *Alaska, *Geochemistry, Water analysis, Groundwater, Mineral springs, Volcanic springs, Volcanoes.

This paper is concerned with the geochemistry of regional groundwaters and mineral springs and mud volcanoes of the Copper River Basin, Alaska. It is part of a recent study undertaken by the Alaska Division of Geological and Geophysical Surveys (ADGGS) to assess the geothermal resources of the area. The Copper River Basin is located in southcentral Alaska, and is bounded to the north by the Alaska Range, on the east by the Wrangell Mountains, on the south by the Chugach Range and on the west by the Talkeetna Mountains. In the immediate vicinity of the basin, extreme elevations of the bounding mountains range from 8,000 feet in the Talkeetna Mountains to 16,000 feet in the Wrangell Mountains, which are volcanic in origin. Within the study area, Mt. Drum has erupted as recently as 200,000 years B.P. Mt. Wrangell continues to emit steam and ash, and has undergone a heating event within the last 10 years. With reference to the previously published chemical data, the questions addressed in this paper are: (1) What are the chemical differences among the regional groundwater.; (2) With what mineral phases are the different waters equilibrated.; (3) Can either of the mud-volcano waters be derived by simple mixing of meteoric water with the remaining mud-volcano water.; and, What can be said the mud-volcano water and gases based on the geochemistry of this water. (See also W87-00892) (Lantz-PTT)
W87-00907

ENVIRONMENTAL ISOTOPES: PRINCIPLES AND APPLICATIONS IN GROUND WATER GEOCHEMICAL STUDIES IN ALBERTA, CANADA,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 2F.
W87-00908

GROUND WATER AGE DETERMINATIONS, PICEANCE CREEK BASIN, COLORADO,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W87-00909

MAJOR ION AND ISOTOPE GEOCHEMISTRY OF GROUND WATER IN CLAYEY TILL, NORTHWESTERN WISCONSIN, USA,
Wisconsin Geological and Natural History Survey, Madison.
For primary bibliographic entry see Field 2F.
W87-00910

REVIEW OF MICROBIAL INFLUENCES ON THE EVOLUTION OF GROUND WATER

CHEMISTRY WITH SOME PRACTICAL APPLICATIONS FROM COAL MINE RECLAMATION STUDIES IN ALBERTA,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 5C.
W87-00911

WATER ANALYSIS, VOLUME 1: INORGANIC SPECIES.
Academic Press, Inc., Orlando, FL. Part 1, 1982. Edited by Roger A. Minear and Lawrence H. Keith. 287 p.

Descriptors: *Water chemistry, *Geochemistry, *Water analysis, *Inorganic compounds, *Natural waters, *Wastewater, Hydrolysis, Redox potential, Alkalinity, Acidity, Conductance, Turbidity, Water quality.

This book presents a background on the inorganic constituents found in water. A general treatment of the sources or representative species found in both natural waters and wastewaters is followed by a discussion on the effects of hydrolysis, complexation, and dissolution in conjunction with redox and pH in the environmental dynamics of these species. This sets the stage for a detailed discussion of these topics in the succeeding two chapters. The fourth chapter deals with conductance, a general measure of solution ionic content. Both reaction rates and equilibrium composition in water are regulated by ionic strengths so that solution behavior is ultimately tied to the nature and the total amount of dissolved species, which, in turn, can be measured by conductance. Although conductance measurements are thus a widely applied parameter in aqueous measurements, they do have their limits of use and interpretation. So the underlying theory is presented with the practical applications to guide the reader in the proper use and interpretation of conductance data. This same format will be found in most of the chapters throughout this work. Turbidity, like conductance, is an indirect or surrogate measurement of some of the components comprising that complex material we refer to as 'water.' However, while conductance measurements pertain to charged, dissolved species in water, turbidity measurements relate to undissolved, suspended matter in water. This relationship is not a simple one, and the in-depth treatment of light scattering theory principles, are intended to give the reader a sufficient understanding of the complexity of turbidimetric responses so that application and interpretation of turbidimetric data can be applied intelligently. Chapter 6 concludes this volume with a survey of general water quality analytical procedures used for measuring individual inorganic species. (Lantz-PTT)
W87-00913

ORIGIN AND NATURE OF SELECTED INORGANIC CONSTITUENTS IN NATURAL WATERS,
University of Southern California, Los Angeles. Environmental Engineering Program.
B. A. Eichenberger, and K. Y. Chen.
IN: Water Analysis, Volume 1: Inorganic Species, Part 1, 1982. Academic Press, Inc., Orlando, FL. p 1-54, 1 tab, 255 ref.

Descriptors: *Water chemistry, *Geochemistry, *Path of pollutants, *Inorganic compounds, *Natural waters, *Weathering, *Fallout, Surface water, Minerals, Metals, Water properties.

Inorganic species enter natural waters from a variety of sources. The weathering of rocks and soils directly exposed to surface waters is usually the largest natural source. Atmospheric fallout of particulate matter from natural sources as well as from anthropogenic inputs, which include the combustion of fossil fuels and material processing, can introduce relatively large quantities of inorganic species into natural water systems. Other anthropogenic inputs, including the discharging of various treated and untreated liquid wastes to the receiving waters of the contamination of the aquatic system through various construction, mining, lumbering, or similar activities, can introduce large quantities of inorganic constituents into natural waters. Degradation products of plant and animal tissue also contribute small amounts of inorganic species to receiving waters. Natural water systems are highly complex electrolyte solutions in contact with a variety of inorganic and organic solids. Inorganic constituents from whatever source, once having entered natural water systems, are subject to the complex abiotic and biological interactions occurring in the natural environment. The solubility of minerals and coordination compounds of inorganic ions is considered the most important phenomenon responsible for the presence of trace elements in natural waters. The significant parameters controlling the solubility of mineral phases are the pH and redox of the solution, the type and concentration of complexing inorganic and organic ligands and chelating agents, and the oxidation state of the mineral components. (Lantz-PTT)
W87-00914

REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,
Maryland Geological Survey, Baltimore.
O. P. Bricker.
IN: Water Analysis, Volume 1: Inorganic Species, Part 1, 1982. Academic Press, Inc., Orlando, FL. p 55-83, 11 fig, 2 tab, 101 ref.

Descriptors: *Redox potential, *Oxidation, *Reduction, Metals, Nitrogen, Sulfur, Hydrogen ion concentration, Water systems, Electrodes, Hydrogen, Calomel, Silver chloride, Geochemistry.

Oxidation and reduction (redox) reactions play an important role in determining the behavior of many elements in the environment. For example, the mobilities of a large number of metals and the aqueous forms of biologically important elements such as nitrogen and sulfur are strongly dependent upon the redox potential. Indeed, the energy to support non-photosynthetic forms of life is largely derived from redox reactions. Previous investigations compiled from the literature all of the redox and pH measurements that they considered to be reliable and, along with their own extensive measurements, attempted to define the redox potential (E sub h)-pH limits of the natural environment. Discussed in this chapter is the E sub h, which is related to the activity of electrons in the same manner that pH is related to the activity of protons (H(+)). Redox measurements have been used, frequently misused, by investigators in many diverse fields over the past four decades. Properly applied, the redox potential is a very useful parameter in describing and predicting the behavior of many important elements that occur in more than one oxidation state in the natural environment. Measurement of redox potentials using the electrode pair, consisting of one inert metal electrode coupled with a reference electrode of hydrogen, calomel or silver-silver chloride, is discussed. (Lantz-PTT)
W87-00915

ALKALINITY AND ACIDITY,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. R. Kramer.
IN: Water Analysis, Volume 1: Inorganic Species, Part 1, 1982. Academic Press, Inc., Orlando, FL. p 85-135, 7 fig, 5 tab, 20 ref.

Descriptors: *Alkalinity, *Acidity, *Natural waters, Chemical analysis, Gran analysis, Hydrogen ion concentration, Laboratory equipment, Titration, Chemical properties, Rainfall, Chemistry of precipitation, Geochemistry.

Alkalinity is a routinely measured parameter for natural waters and wastewaters, whereas acidity is less commonly measured but is involved at least conceptually in the analysis of low-pH solutions such as rainfall. Standard procedures simplify the recipe for analysis of alkalinity and acidity to a titration to one equivalence point, although since equivalence points vary with concentration, more refined methods have been developed. The basis of this concentration dependence is developed along with the concept of equivalence point, endpoint, and buffer capacity of different systems. Stable pH meters are now commonly available and permit the analysis of linearized segments of a titration curve is commonly called a 'Gran analysis' or 'modified Gran analysis'. This technique greatly increases the precision of analysis, requires fewer assumptions, and can be used to obtain more information about the solution from the determination of dissociation constants. The basis of the Gran analysis and laboratory and field methods using it are described. Alkalinity is a concentration measure typically involving an electrode system, responding to activities. The significance of constant ionic strength, electrode effects, and response are discussed in detail, and an alternative approach to the use of pH buffers is proposed. This chapter also deals with other systems as well as the carbonate system. (Author's abstract)
W87-00916

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,
J. D. Hem.
IN: Water Analysis, Volume 1: Inorganic Species, Part 1, 1982. Academic Press, Inc., Orlando, FL. p 137-161, 7 fig, 28 ref.

Descriptors: *Conductance, *Dissolved ions, *Aqueous solutions, Specific conductance, Equivalent conductance, Ionic mobility, Laboratory equipment, Chemical properties, Data interpretation, Experimental design.

This chapter briefly considers the physical basis for electrical conductance in aqueous solutions (specific conductance and equivalent conductance), the influence of solute concentrations and related factors on conductance (ionic mobility), and the ways in which these influences can be evaluated. The techniques and instruments used for measuring conductance are described and the use of the measured values in various types of interpretations of interest in the field of water chemistry and water anlaysis are then reviewed. Users of water analyses have developed relations that can be used in making estimates of dissolved ionic concentrations based on conductivity determinations. Applicability and reliability limits for these kinds of estimates are explored. (Lantz-PTT)
W87-00917

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,
Hach Co., Loveland, CO.
For primary bibliographic entry see Field 5A.
W87-00918

PRECIPITATION CHEMISTRY,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W87-00974

PHOTOOXIDATION OF THIOETHER PESTICIDES ON SOIL SURFACES,
Nevada Univ., Reno. Dept. of Biochemistry.
For primary bibliographic entry see Field 5B.
W87-01117

HILLSLOPE HYDROCHEMISTRY AND STREAM RESPONSE ON A WOODED, PERMEABLE BEDROCK: THE ROLE OF STEMFLOW,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W87-01169

CHARACTERISTICS OF AN UNUSUAL HIGHLY ALKALINE WATER FROM THE MAQARIN AREA, NORTHERN JORDAN,
Jordan Univ., Amman. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 2F.
W87-01173

GROUNDWATER RECHARGE ESTIMATION USING CHLORIDE, DEUTERIUM AND

OXYGEN-18 PROFILES IN THE DEEP COASTAL SANDS OF WESTERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2F.
W87-01174

HEAVY METAL CONTENT OF RAINWATER IN GENEVA, NEW YORK, DURING 1983,
Hobart and William Smith Colleges, Geneva, NY. Dept. of Chemistry.
For primary bibliographic entry see Field 2B.
W87-01222

SEPARATION AND PRECONCENTRATION OF HEAVY METALS IN ENVIRONMENTAL SAMPLES BY NICOTINIUM MOLYBDOPHOSPHATE RESIN,
Makerere Univ., Kampala (Uganda). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-01223

DETERMINATION OF THE COMPONENTS OF STORMFLOW USING WATER CHEMISTRY AND ENVIRONMENTAL ISOTOPES, MATTOLE RIVER BASIN, CALIFORNIA,
Geological Survey, Menlo Park, CA.
V. C. Kennedy, C. Kendall, G. W. Zellweger, T. A. Wyerman, and R. J. Avanzino.
Journal of Hydrology JHYDA7, Vol. 84, No. 1/2, p 107-140, April 15, 1986. 9 fig, 2 tab, 70 ref.

Descriptors: *Chemical composition, *Rainfall, *Runoff, *Storm runoff, Mattole River, California, Water quality, Geochemistry, Isotope studies, Soil water.

The chemical and isotopic composition of rainfall and stream water was monitored during a storm in the Mattole River basin, northwestern California, in January 1972. About 250 mm of rain fell within 6 days following 24 days of little or no precipitation. River discharge increased from 22 to a peak of 1300 cu meters per sec; chloride and silica concentrations decreased from 3.2 to 2.1 and 11.5 to 8.6 mg per liter, respectively. Despite the large volume of storm runoff and the low solute content of the rainfall, the concentration of some solutes in the runoff remained remarkably stable. Similarly, although the isotopic content of the rain was highly variable and quite different from that of prestorm river water, the isotopic composition of the river water changed relatively little. A major factor in the formation of stormflow is believed to be displacement of prestorm soil water by the rain. The lateral movement of water through soils on the hillslopes probably accounts for the stabilization, which occurs in the interfluve areas during a relatively short period, up to a few tens of hours. It appears inappropriate to draw conclusions about the relative proportions of groundwater and rainfall in runoff from a particular storm based only on the average compositions of rainfall, stormflow, and prestorm river water. (Cassar-PTT)
W87-01267

METHOD FOR PREDICTING THE RATE OF ABIOTIC DEGRADATION OF ORGANIC CHEMICALS IN THE ENVIRONMENT, (EINE VORAUSSAGEMETHODE ZUM ABIOTISCHEN ABBAUVERHALTEN VON ORGANISCHEN CHEMIKALIEN IN DER UMWELT),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Radiochemie.
For primary bibliographic entry see Field 5B.
W87-01334

PRACTICAL APPLICATION OF THE EQUIVALENCE TEST USING THE DETERMINATION OF NITRATE AND NITRITE IONS AS AN EXAMPLE, (DIE PRAKTISCHE ANWENDUNG DES GLEICHWERTIGKEITSTESTES AM BEISPIEL DER BESTIMMUNGEN DER NITRAT- UND NITRIT-IONEN),
For primary bibliographic entry see Field 5A.
W87-01340

SIZE FRACTIONATION TECHNIQUES IN THE DETERMINATION OF ELEMENTS ASSOCIATED WITH PARTICULATE OR COLLOIDAL MATERIAL IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Dept. of Chemistry.
B. Salbu, H. E. Bjornstad, N. S. Lindstrom, E. Lydersen, and E. M. Brevik.
Talanta TLNTA2, Vol. 32, No. 9, p 907-913, September 1985. 3 fig, 4 tab, 11 ref.

Descriptors: *Groundwater quality, *Water analysis, *Size fractionation, *Particulate matter, *Colloidal matter, *Fresh water, Trace elements, Filtration, Centrifugation, Ultrafiltration, Element distribution, Dialysis.

Among fractionation techniques applied to trace-element speciation studies in natural water samples, methods based on size separations are by far most commonly applied. In the present work, methodological effects occurring in use of filtration, centrifugation, dialysis in situ and hollow-fibre ultrafiltration are discussed. By using combinations of these techniques and different methods of analysis, information on the association of 20 elements with particulate or colloidal material in ground water and lake water was obtained. It was discovered that the colloidal fraction contributed significantly to the transport of trace metals in natural waters. (Main-PTT)
W87-01415

ESTIMATION OF TDS IN SAND AQUIFER WATER THROUGH RESISTIVITY LOG,
China Geoexploration and Waterwell Engineering Corp., Karachi (Pakistan).
For primary bibliographic entry see Field 2F.
W87-01490

DETERMINATION OF COBALT IN NATURAL WATERS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY AFTER MICRO SOLVENT EXTRACTION WITH CAPRIQUAT,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W87-01501

GEOCHEMISTRY AND AQUEOUS CHEMISTRY OF ALUMINUM,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1B.
W87-01502

OCTANOL:WATER PARTITION COEFFICIENTS (P): MEASUREMENT, ESTIMATION, AND INTERPRETATION, PARTICULARLY FOR CHEMICALS WITH P > 100000,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
For primary bibliographic entry see Field 5B.
W87-01508

PHOSPHORUS ADSORPTION TO RIVERINE SUSPENDED MATTER: IMPLICATIONS FOR THE P-BUDGET OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W87-01546

MEASUREMENT AND MODELING OF WESTERN WASHINGTON PRECIPITATION CHEMISTRY,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-01561

BUFFER CAPACITY OF FOREST SOILS IN NEW ENGLAND,
Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 5B.
W87-01565

DEPOSITION CHEMISTRY DETERMINED VIA SULFUR AND IRON AS INDICATORS,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Lab. of Inorganic Analytical and Nuclear Chemistry.
J. P. Hallet, C. Ronneau, and J. Cara.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 2, p 211-218, October 1985. 2 fig, 3 tab, 11 ref.

Descriptors: *Deposition, *Air pollution, *Fallout, *Water pollution sources, *Chemical properties, *Sulfur, *Iron, *Indicators, *Chemistry of precipitation, Path of pollutants, Chemical analysis.

Multi-elemental monitoring of dry and wet deposition of pollutants is difficult and time-consuming. However, sulfur and iron are easily determined in deposition water samples by simple and inexpensive methods, and can be used as indicators at semi-remote to remote sites because of quantitative correlations between the deposition rates of these elements and of others, including cesium, cobalt, chromium, selenium, lanthanum, rubidium, etc. These correlations exist because relative emission factors are very similar from one country to another, and because the deposition behavior of elemental pollutants is remarkably constant due to similarities in granulometry of a given element at different sites. Sulfur mostly is associated with finer particles (less than 1 micron) and characteristic of elements highly enriched in the air as a result of igneous processes, and iron is associated with coarser particles and from both pedogenic and industrial origin. (Doria-PTT)
W87-01567

CHEMICAL CHANGES IN A RECEIVING STREAM DUE TO OXYGENATION AND DILUTION OF MINE TAILINGS SEEP WATERS,
Montana State Univ., Bozeman. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-01568

FACTORS AFFECTING TRACE METAL UPTAKE AND TOXICITY TO ESTUARINE ORGANISMS: I. ENVIRONMENTAL PARAMETERS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
For primary bibliographic entry see Field 5C.
W87-01723

FACTORS AFFECTING TRACE METAL UPTAKE AND TOXICITY TO ESTUARINE ORGANISMS: II. CELLULAR MECHANISMS,
National Inst. of Environmental Health Sciences, Research Triangle Park, NC. Lab. of Organ Function and Toxicology.
For primary bibliographic entry see Field 5C.
W87-01724

NUTRIENT AND METAL CONCENTRATIONS IN THE SURFACE SEDIMENT LAYERS OF THE KITKAJARVI LAKES,
Water District Office of Oulu (Finland).
For primary bibliographic entry see Field 2H.
W87-01740

INFLUENCE OF DRAINAGE AREA FACTORS ON THE WATER QUALITY OF SMALL LAKES IN THE KOUTAJOKI RIVER BASIN WITH SPECIAL REFERENCE TO METALS,
Water District Office of Oulu (Finland).
For primary bibliographic entry see Field 2H.
W87-01741

CORRELATIONS BETWEEN WATER QUALITY VARIABLES IN FINNISH LAKES,
For primary bibliographic entry see Field 2H.
W87-01742

REGIONAL DISTRIBUTION OF SOME WATER QUALITY VARIABLES IN FINNISH COASTAL WATERS,
For primary bibliographic entry see Field 5B.
W87-01744

CAUSES OF INCREASED FISH MERCURY LEVELS IN FINNISH RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W87-01749

ORGANIC AND INORGANIC MERCURY IN THE FOOD CHAIN OF SOME LAKES AND RESERVOIRS IN FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-01750

SELENIUM AND MERCURY CONTENTS IN NORTHERN PIKE (ESOX LUCIUS, L.) OF FINNISH MAN-MADE AND NATURAL LAKES,
For primary bibliographic entry see Field 5B.
W87-01751

SCPP METEOROLOGICAL AND STATISTICAL SUPPORT FOR PERIOD 1 SEPTEMBER 1984 - 31 AUGUST 1985, VOLUME II: (EXPERIMENTAL DAY SUMMARIES) INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 7B.
W87-01763

2L. Estuaries

ESTUARINE ECOLOGY OF THE SOUTHEASTERN UNITED STATES AND GULF OF MEXICO,
Southern Illinois Univ. at Carbondale. Fisheries Research Lab.
R. R. Stickney.
Texas A & M University Press, College Station, TX. 1984. 310 p.

Descriptors: *Estuaries, *Ecology, *Ecosystems, Aquatic life, Marine biology, Wetlands, Marshes, Aquatic animals, Aquatic plants, Fish, Saline-freshwater interfaces, Sediments, Water quality, Zooplankton, Detritus, Benthos, Chemical reactions, Birds, Waterfowl, Mammals, Wildlife, Gulf of Mexico, Water pollution.

The physical, chemical, geological, and biological characteristics of estuaries are examined in this book, which is primarily concerned with the estuaries of the southeastern U.S. and Gulf of Mexico. These areas are harsh and demanding ecosystems, which shelter a large variety of flora and fauna. The author concludes that much of the environmental movement of the 1960's and 1970's was based on emotionalism, and exaggeration instead of scientific evidence. However, this spirit has resulted in many laws to clean the air and water. Topics addressed are basic marine and estuarine science, freshwater inflow, sedimentary processes, physical relationships (marshlands, lagoons, negative estuaries, tides, waves, currents, light, salinity, temperature), estuarine chemistry (nutrients, organic matter, trace metals), primary producers and decomposers, zooplankton, benthos, estuarine fishes, higher vertebrates, and man's impact on estuaries. (Cassar-PTT)
W87-00921

TRANSPORT MODELS FOR INLAND AND COASTAL WATERS.
International Association for Hydraulic Research, Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W87-00922

MATHEMATICAL MODELING OF FLOWS AND TRANSPORT OF CONSERVATIVE SUBSTANCES: REQUIREMENTS FOR PREDICTIVE ABILITY,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W87-00923

PREDICTIVE ABILITY OF ONE-DIMENSIONAL ESTUARY MODELS,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 5B.
W87-00924

MODELING OF LAGOONS: THE EXPERIENCE OF VENICE,
Padua Univ. (Italy). Ist. di Idraulica.
For primary bibliographic entry see Field 5B.
W87-00926

TECHNIQUES FOR FIELD VERIFICATION OF MODELS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W87-00927

NUMERICAL MODELING OF FREE-SURFACE FLOWS THAT ARE TWO-DIMENSIONAL IN PLAN,
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W87-00929

TWO-DIMENSIONAL TIDAL MODELS FOR THE DELTA WORKS,
RAND Corp., Santa Monica, CA.
J. J. Leendertse, A. Langerak, and M. A. M. de Ras.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 408-450, 30 fig, 3 ref.

Descriptors: *Sediment transport, *Estuaries, *Environmental effects, *Model studies, *Salinity, *Prediction, Accuracy, Mathematical models, Water quality, Tides, Water current, Delta works, The Netherlands, North Sea, Sediment transport.

Changes in offshore tidal currents and resulting effects on sediment transport are being studied in the Delta Works region of the Netherlands. Here a storm surge barrier and other flow control works are being constructed. The model also predicts salinity and water quality in the Oosterschelde as a result of these structures. Grid sizes used were 1600 m, 800 m, and 400 m. These model studies were used, not only to study construction alternatives, but to validate other models. (See also W87-00922) (Cassar-PTT)
W87-00932

PREDICTIVE SALINITY MODELING OF THE OOSTERSCHELDE WITH HYDRAULIC AND MATHEMATICAL MODELS,
Rijkswaterstaat, The Hague (Netherlands).
J. Dronkers, A. G. van Os, and J. J. Leendertse.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 451-482, 2 fig, 2 tab, 10 ref.

Descriptors: *Estuaries, *Saline water intrustion, *Environmental effects, *Model studies, *Prediction, Accuracy, Mathematical models, Water quality, Tides, Salinity, Delta Works, The Netherlands, North Sea, Oosterschelde, Hydraulic models.

Hydraulic and mathematical models were used to study the effects of building a storm surge barrier and two secondary dams in the Oosterschelde. One goal was to keep the salinity near to normal to support the fish nursery. Some preliminary conclusions are available with respect to the predictive abilities of the two-dimensional integrated mathematical model. (1) After calibration and verification the tidal water movement in the estuary is simulated very accurately. (2) Concerning the velocity distribution, extrapolation to the future situation can be performed. (3) In the homogeneous part of the Oosterschelde the reproduction of the longitudinal dispersion in the hydraulic model is accurate enough to insure an accuracy within the required standard of 2 ppt. (4) For research on calamities such as the 1953 storm and flood, special attention should be paid to the proper value of the lateral dispersion coefficient. A smaller grid size should be used. (See also W87-00922) (Cassar-PTT)
W87-00933

TWO-DIMENSIONAL, LATERALLY AVERAGED MODEL FOR SALT INTRUSION IN ESTUARIES,
Waterloopkundig Lab. te Delft (Netherlands).
P. A. J. Perels, and M. Karelse.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 483-535, 19 fig, 3 tab, 39 ref, 4 append.

Descriptors: *Model studies, *Estuaries, *Prediction, *Saline water intrusion, Accuracy, Mathematical models, Turbulent flow, Numerical models.

A two-dimensional laterally averaged salt intrusion model was calibrated and verified using a single tidal flume. With respect to predictive abilities: (1) For a flume the tidal flow is predictable with acceptable accuracy, providing the proper bottom roughness coefficient is found and the upstream and downstream boundary conditions accurately specified. (2) The concentration distribution must be considered as not predictable. (3) The problem of dispersion due to lateral averaging could be avoided by using a three-dimensional model. (4) The transition function is a separate problem. (See also W87-00922) (Cassar-PTT)
W87-00934

CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY; PHASE II: BIOTA ASSESSMENT; FINAL REPORT,
Western Eco-Systems Technology, Inc., Bothell, WA.
G. B. Mackiernam, D. F. Bleil, and G. B. Shea.
Available from the National Technical information Service, Springfield, VA. 22161, as ADA 125260, Price codes: A13 in paper copy, A01 in microfiche. May 1982. 207 p, 50 fig, 13 tab, 49 ref. Contract No DACW31-79-C-0056.

Descriptors: *Estuaries, *Salinity, *Aquatic habitats, *Drought, Habitats, Aquatic animals, Zooplankton, Invertebrates, Chesapeake Bay, Low flow, Flow, Model studies, Benthos, Seasonal variation, Fish, Shellfish, Phytoplankton, Marshes.

An assessment of the effects of low freshwater flow conditions on the biota of Chesapeake Bay was conducted through use of data output from the U.S. Army Corps of Engineers' Chesapeake Bay Hydraulic Model. Phase I of the biota assessment focused on methodology development and establishment of a baseline for determination of freshwater inflow-induced change. Physical and chemical information, along with salinity tolerance and other habitat related information was collected for a group of over 50 study organisms. In Phase II of the assessment, four sets of hydraulic model test conditions (scenarios) were used which simulated effects of drought and effects of future consumptive water use as deviations from present average flow conditions. Changes in habitat for the selected study organisms were predicted and mapped based on salinity and other variables. Changes in habitat which were used to delineate the amount of impact from reduced freshwater inflow, were found to include increases and decreases depending on the species, its lifecycle, tolerances, and interactions with other organisms. The magnitude of habitat

change was found to generally increase as salinity changes increased. (Author's abstract)
W87-00945

PROCEEDINGS OF THE WORKSHOP ON AGRICHEMICALS AND ESTUARINE PRODUCTIVITY.
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Marine Pollution Assessment.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-170308, Price codes: A12 for paper copy, A01 in microfiche. Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980.December 1982. 294 p.

Descriptors: *Estuaries, *Water pollution effects, *Fate of pollutants, *Agricultural chemicals, Pesticides, Aquatic animals, Aquatic plants, Water quality control.

This workshop proceedings consists of 19 papers on the effects of agriculture (particularly chemicals) on the estuarine environment. Topics concern the characteristics and uses of an estuary; use, effects, and fate of pesticides and fertilizers; monitoring and analytical methods; and opportunities for minimizing the impacts of chemicals on this environment. (See also W87-00959 thru W87-00970) (Cassar-PTT)
W87-00957

DEFINITION OF AN ESTUARY,
Chesapeake Research Consortium, Inc., Annapolis, MD.
L. E. Cronin.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 1-16, 10 fig.

Descriptors: *Estuaries, *Water pollution sources, *Sediments, *Aquatic life, Water circulation, Tides, Water currents, Fish, Water pollution effects, Salinity, Suspended sediments, Dredging, Benthos, Fate of pollutants, Phytoplankton, Marshes, Zooplankton, Aquatic plants.

An estuary exists where a river meets the sea. It may be defined as a semi-enclosed body of water in which land-source water and ocean-source water are present in measurable amounts. The principal types are coastal plain, lagoons, and fjords. Estuaries contain many gradients, i.e., salinity, currents, water depth, sediments, aquatic life. Vast quantities of water are moved by tidal forces. Circulation is complex, driven by flows, tides, wind, and density differences. Change is continuous. Sediments are extremely important because they settle, resuspend, relocate, and resettle, affecting light, the substrate, and water chemistry. The natural tendency of an estuary is to fill with sediment unless dredged or otherwise altered. Chemical input from land is continuous and variable. Many substances can be bioaccumulated; some are continuously recycled among water, sediments, and biota. A unique set of organisms is present. They are environmentally tough and produce large numbers of individuals. The bottom-living benthos are particularly rich. The estuary is an important spawning and nursery ground for fish and other marine and terrestial species. Although resilient to natural events, estuaries are sensitive to exotic chemicals. (See also W87-00957) (Cassar-PTT)
W87-00958

USES AND MISUSES OF ESTUARIES,
Environmental Research Lab., Gulf Breeze, FL.
T. W. Duke.
IN: Proceedings of the Workahop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 17-34, 3 tab, 32 ref.

Descriptors: *Estuaries, *Water pollution effects, *Water pollution sources, *Oil, Oil spills, Fate of pollutants, Aquatic life, Fish, Sedimentation, Dredging, Sediment transport, Industrial wastes, Municipal wastewater, Wastewater pollution, Thermal pollution, Heated water, Pathogens, Wastewater disposal, Water quality, Habitats, Aquatic habitats.

Estuaries are used for many purposes. This paper concentrates on the stresses possible with exploration and production of oil, dredge-and-fill operations, and industrial and municipal effluents. Petroleum products enter the estuary from several sources; the highest percentages are river runoff (35.1%), tankers and other methods of transportation (21.22%), and the atmosphere (11.92%). Many studies have been conducted to evaluate the effects of this pollutant on the environment. Larval populations are especially vulnerable. Most marine populations recover from a severe oil spill. Barium sulfate, a component of drilling mud, has a deleterious effect on the benthos. Dredge-fill operations can improve or adversely affect an estuary. Beneficial results include improvement of navigation and creation of new shellfish habitats. Adverse effects include smothering shellfish beds, degrading water quality, increasing turbidity, and decreasing dissolved oxygen concentrations. Several examples of the fate and effects of industrial and municipal effluents entering estuaries are described. Other stressors to the estuarine environment are thermal pollution from powerhouse cooling water and pathogens from municipal and pharmaceutical manufacturing waste streams. (See also W87-00957) (Cassar-PTT)
W87-00959

SCIENTIFIC LESSONS TAUGHT BY KEPONE,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W87-00960

MIREX, FIRE ANTS, AND ESTUARIES,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W87-00961

OVERVIEW OF ATRAZINE DYNAMICS IN ESTUARINE ECOSYSTEMS,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 5C.
W87-00962

SIGNIFICANCE OF NON-POINT SOURCES OF NUTRIENTS TO EUTROPHICATION IN THE CHOWAN RIVER,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5C.
W87-00963

FERTILIZER AND PESTICIDE MOVEMENT IN SURFACE WATER,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 5B.
W87-00964

QUALITY OF IRRIGATION RETURN FLOW FROM FLOODED RICE PADDIES,
Texas Agricultural Experiment Station, College Station.
For primary bibliographic entry see Field 5B.
W87-00965

MONITORING AGRICULTURAL CHEMICALS IN ESTUARIES,
For primary bibliographic entry see Field 5A.
W87-00967

ENVIRONMENTAL SAFETY EVALUATION OF DETERGENT CHEMICALS IN ESTUARINE ECOSYSTEMS,
For primary bibliographic entry see Field 5C.
W87-00968

OPPORTUNITIES FOR MINIMIZING IMPACT OF AGRICULTURAL CHEMICALS ON ESTUARINE PRODUCTIVITY,
National Audubon Society, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-00969

NOTE ON THE ENUMERATION OF MANGANESE-OXIDIZING BACTERIA IN ESTUARINE WATER AND SEDIMENT SAMPLES,
Liverpool Univ. (England). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W87-01006

GLYCOLATE METABOLISM BY PSEUDOMONAS SP., STRAIN S22, ISOLATED FROM A COASTAL MARINE SEDIMENT,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
H. M. Edenborn, and C. D. Litchfield.
Marine Biology MBIOAJ, Vol. 88, No. 2, p 199-205, August 1985. 6 fig, 1 tab, 26 ref. NOAA Grants 04-06-022-44020 and 04-07-022-44013.

Descriptors: *Glycolate metabolism, *Pseudomonas, *Marine sediments, *New York Bight, *Marine bacteria, Bacterial physiology, Isotope studies, Magnesium ion, Michaelis-Menten kinetics, Respiration, Carbon metabolism, Lactate metabolism, Monocarboxylate transport system.

The metabolism of glycolate by Pseudomonas sp strain 227, originally isolated from the New York Bight Apex was studied in aerobic culture in GAN medium. The specific growth rate on glycolate was 0.156 doublings/hr. The apparent maximal rate of uptake (V sub max) and Michaelis-Menten constant (K sub m) for glycolate uptake, based on 14C labeling results, were 83.6 nanomole/min per milligram of cell protein and 7.4 x 10 to the minus 8th power molar, respectively. Preferential respiration of the carboxyl carbon (C-1) and the incorporation of the hydroxymethyl carbon (C-2) suggested that the glycerate pathway was used for growth on glycolate. Alternatively, another pathway could be utilized, resulting in complete catabolism of glycolate. Glycolate and lactate metabolism were closely linked either by a common pathway or a common transport system other than the monocarboxylate transport system. The magnesium ion concentration was also important in glycolate metabolism. The characteristics of the glycolate metabolism observed are advantageous in coastal and estuarine environments where glycolate production is intermittent and concentrations are low. (Author's abstract)
W87-01050

TIDAL VARIATIONS IN THE PHOTOSYNTHESIS OF ESTUARINE PHYTOPLANKTON ISOLATED IN A TANK,
Laval Univ., Quebec. Dept. de Biologie.
L. Legendre, S. Demers, J.-C. Therriault, and C.-A. Boudreau.
Marine Biology MBIOAJ, Vol. 88, No. 3, p 301-309, September 1985. 7 fig, 42 ref. Natural Sciences and Engineering Research Council (Canada) Grant A9689.

Descriptors: *Tides, *Photosynthesis, *Phytoplankton, *Estuaries, *Temperature, *Light, *Chlorophyll a, *Ammonia, Semidiurnal cycles, Endogenous cycles, Adaptations, Shade, Mixing, Saint Lawrence Estuary, Canada.

In 1981 two 1,200-liter seawater samples from the St. Lawrence Estuary were kept under constant temperature (9 C or 11 C) and dim light (3 W/sq m) for periods of 50 and 68 hr, respectively. In both tank experiments, semidiurnal variations in NH4 were observed that could be related to cyclical NH4 uptake by the phytoplankton. Semidiurnal cycles in photosynthetic efficiency and intracellular chlorophyll a in the tank, phased on tides at sea, were evidenced in both experiments. These results support the hypothesis that variations in phytoplankton photosynthetic activity, which are possibly endogenous, can be phased on semidiurnal

variations in vertical tidal mixing (variations in the mean light conditions of the mixed layer). In addition, the observed variations in intracellular chlorophyll a suggest the possibility of endogenous cycles of phytoplankton light and shade adaptation. (Author's abstract)
W87-01051

APPLICATION OF CO2-POROMETER METHODS TO ASSESSMENT OF COMPONENTS OF PHOTOSYNTHETIC PRODUCTION IN ESTUARINE ECOSYSTEMS,
Instituto Botanico, Lisbon (Portugal).
F. Catarino, J. D. Tenhunen, V. Brotas, and O. L. Lange.
Marine Biology MBIOAJ, Vol. 89, No. 1, p 37-43, October 1985. 6 fig, 16 ref.

Descriptors: *Carbon dioxide porometer, *Photosynthesis, *Estuaries, *Primary production, *Transpiration, *Algae, Carbon fixation, Light, Temperature, Gas exchange, Plant physiology.

A portable system of CO2 gas exchange measurements is described that allows determination of net photosynthesis and transpiration rates as well as leaf conductance of salt marsh vascular plants and photosynthesis rates of macrophytic algae and epibentihic algae of sediment cores during low tide periods of exposure. Carbon fixation processes of these several different types of organisms can be studied on the same day. Measurements may be carried out at an estuarine field site using controlled conditions of light, temperature, and air CO2 partial pressure. Algal samples are enclosed in a cuvette for only a matter of minutes and do not dry significantly during measurement. The rapidity with which gas exchange rates of samples may be assessed permits routine processing of many sediment cores. (Author's abstract)
W87-01053

MICROPROFILES OF OXYGEN IN EPIPHYTE COMMUNITIES ON SUBMERGED MACROPHYTES,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 2H.
W87-01054

IMPORTANCE OF PICOCYANOBACTERIA BIOMASS (UNICELLULAR, BLUE-GREEN ALGAE) IN THE PHYTOPLANKTON POPULATION OF THE COASTAL WATERS OF JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
M. Takahashi, K. Kikuchi, and Y. Hara.
Marine Biology MBIOAJ, Vol. 89, No. 1, p 63-69, October 1985. 6 fig, 1 tab, 20 ref. Ministry of Education, Science and Culture (Japan), Grant-in-aid for Special Project Research 58480007.

Descriptors: *Cyanophyta, *Phytoplankton, *Japan, *Coastal waters, *Organic carbon, *Epiflourescence microscopy, Kuroshio, Oyashio, Shimoda, Picocyanobacteria, Plasma volume, Chlorophyll, Biomass, Photography.

Picocyanobacteria, which specifically exhibited fluorescence of phycobilin pigments under green light, were enumerated under an epifluorescence microscope. Samples were obtained in the Kuroshio and Oyashio coastal waters between 1 and 9 July 1983 and in the waters off Shimoda, Japan, between 10 and 12 August 1983. The fluorescence, and various morphological and chemical characters of the picocyanobacteria were evaluated using monospecific strains isolated from the study area. Plasma volume determined with the epifluorescence microscope photographs was converted to cellular organic carbon using a relation obtained from the isolates. Percentages of the picocyanobacteria biomass in terms of cellular carbon ranged from 8.3 to 79.4% of the total picophytoplankton (less than 3 micron) and between 4.7 to 46.4% of the total phytoplankton. The larger percentages of the picocyanobacteria occurred consistently in low-chlorophyll waters. (Author's abstract)
W87-01055

BLOOMS OF THE DINOFLAGELLATE GYRODINIUM AUREOLUM IN A LONG ISLAND ESTUARY: BOX MODEL ANALYSIS OF BLOOM MAINTENANCE,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5C.
W87-01056

VERTICAL DISTRIBUTION OF MESOPLANKTON IN THE OPEN AREA OF THE BLACK SEA,
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
M. E. Vinogradov, M. V. Flint, and E. A. Shushkina.
Marine Biology MBIOAJ, Vol. 89, No. 1, p 95-107, October 1985. 11 fig, 22 ref.

Descriptors: *Mesoplankton, *Black Sea, *Vertical distribution, *Oxygen, *Oxycline, *Isooxygen surface, Coelenterates, Ctenophores, Copepods, Chaetognaths, Daily cycle, Vertical migration.

The vertical distribution of mesoplankton in the Black Sea was studied in April-May 1984 by sampling with a 150-liter water bottle, vertical plankton nets with mesh sizes of 180 and 500 mkm (No. 38 and No. 14, respectively), and by direct counting of the jelly-fish Aurelia aurita, the ctenophore Pleurobrachia pileus, Calanus helgolandicus, and the chaetognath Sagitta setosa from the manned submersible 'Argus'. During daytime throughout the whole deep-water body of the sea near the lower oxycline boundary, plankton forms a layer of high concentration (2.5 to 38 g/cu m); its thickness varies from 5 to 10-20 m and it has an unchangeable vertical structure, with its upper portion formed by P pileus, its middle portion by V-VI copepodites of C helgolandicus, and its lower portion by the population of S setosa. The lower boundary of this layer coincides with 0.4 to 0.5 ml O2/liter isooxygen surface, and its depth varies in different areas of the Black Sea from 150 to 50 m, depending on the depth location of 0.5 ml O2/liter isooxygen surface. By night, the animals that form this layer migrate towards the surface. (Author's abstract)
W87-01057

EFFECT OF SELENITE AND SELENIFEROUS FLY-ASH LEACHATE ON GROWTH AND VIABILITY OF THE MARINE AMPHIPOD ALLORCHESTES COMPRESSA,
Australian Atomic Energy Commission Research Establishment, Sutherland.
For primary bibliographic entry see Field 5C.
W87-01059

DISSOLVED ORGANIC SUBSTANCES DURING A PHAEOCYSTIS POUCHETII BLOOM IN THE GERMAN BIGHT (NORTH SEA),
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
For primary bibliographic entry see Field 5C.
W87-01061

PARTICULATE DNA IN SUBTROPICAL OCEANIC AND ESTUARINE PLANKTONIC ENVIRONMENTS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
J. H. Paul, W. H. Jeffrey, and M. DeFlaun.
Marine Biology MBIOAJ, Vol.90, No. 1, p 95-101, December 1985. 4 fig, 3 tab, 33 ref. NSF Grants OCE-8415605 and BSR 83-07366.

Descriptors: *Deoxyribonucleic acid, *Estuaries, *Oceans, *Trophic level, *Florida, *Gulf of Mexico, *Particulate organic carbon, *Particulate organic nitrogen, *Chlorophyll a, *Bacteria, Thymidine incorporation, Isotope studies, Correlation, Genetics, Plankton, Biomass, Cytology.

Particulate DNA was measured in estuarine, coastal, and oligotrophic oceanic environments near the southwest coast of Florida and in the Gulf of Mexico. Particulate organic carbon and nitrogen (POC and PON), chlorophyll a, bacterial direct counts, DNA, and bacterial activity as determined by thymidine incorporation all showed a high degree of intercorrelation. Normalization of the data for offshore/onshore similarities by dividing by POC yielded significant correlations only for DNA, direct counts, and bacterial activity. Most (70-99%) of the particulate DNA in offshore samples was in the 0.1- to 1-micron fraction, whereas DNA in nearshore and estuarine samples was associated with larger particles. Cellular DNA contents obtained by dividing DNA by direct counts in the 0.2- to 1-micron fraction were in the range of reported bacterial genome weights. DNA nitrogen comprised a greater proportion of the PON than reported for microorganisms in culture. Collectively, these results suggest that (1) most of the particulate DNA in oceanic environments is contained in bacterioplankton; and (2) DNA is a significant proportion of cell biomass, possibly due to growth under nutrient-limiting conditions. (Author's abstract)
W87-01062

UPTAKE AND TRANSLOCATION OF PHOSPHORUS IN EELGRASS (ZOSTERA MARINA),
Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 5B.
W87-01063

SOURCES AND CONCENTRATIONS OF VASCULAR PLANT MATERIAL IN SEDIMENTS OF BUZZARDS BAY, MASSACHUSETTS, USA,
Marine Biological Lab., Woods Hole, MA.
J. O. Wilson, I. Valiela, and T. Swain.
Marine Biology MBIOAJ, Vol. 90, No. 1, p 129-137, December 1985. 3 fig, 5 tab, 35 ref. NSF Grants DEB 79-05127 and BSR 82-17040.

Descriptors: *Bottom sediments, *Buzzards Bay, *Lignin, *Stable carbon isotopes, *Spartina alterniflora, Phytoplankton, Organic carbon, Isotope studies, Massachusetts, Diagenesis, Great Sippewissett Marsh, Sediment distribution, Estuaries.

Samples of surface sediment from Buzzards Bay and creek sediment from Great Sippewissett Marsh were analyzed for lignin and stable carbon isotope composition in 1984. The lack of change in composition of lignins in detritus of Spartina alterniflora over 2 yr of decomposition and similar aldehyde-acid ratios of lignin oxidation products of plant and sediment samples indicated minimal diagenesis of lignins in sediments. Remains of non-woody angiosperm tissues made up the bulk of the vascular plant debris in Buzzards Bay and Great Sippewissett Marsh sediments. These plant remains were evenly distributed over the sampling area in Buzzards Bay. Based on model calculations, salt marshes potentially contributed a significant fraction of the total amount of vascular plant debris in coastal marine sediments. The bulk of the organic matter in Buzzards Bay sediments, however, was derived from phytoplankton; vascular plant remains made up only 5-7% of the total amount of organic C in these sediments. (Author's abstract)
W87-01064

TRACE METALS IN MUSSELS (MYTILUS EDULIS) FROM SOUTHWEST ICELAND,
Marine Research Inst., Reykjavik (Iceland).
For primary bibliographic entry see Field 5B.
W87-01065

MICROOXIC-ANOXIC NICHE OF BEGGIATOA SPP.: MICROELECTRODE SURVEY OF MARINE AND FRESHWATER STRAINS,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-01080

SEM COMPARISON OF FRUITS OF A SEAGRASS, HALODULE (CYMODOCEACEAE), FROM AUSTRALIA AND TEXAS,
Texas Univ. at Arlington. Dept. of Biology.

L. H. Bragg, and C. McMillan.
American Journal of Botany AJBOAA, Vol. 73, No. 6, p 815-821, June 1986. 21 fig, 15 ref.

Descriptors: *Halodule, *Fruits, *Marine sediments, *Morphology, Scanning electron microscopy, Shark Bay, Australia, Texas, Seed coats, Hypocotyls, Starch grains, Cells, Cotyledons, Plumules, Taxonomy.

Fruits of Halodule were collected from marine sediments in Shark Bay, Western Australia, and in Laguna Madre, Texas, and compared using scanning electron microscopy (SEM). The fruits of the Australian collection had a more deeply furrowed wall surface, and the fruits of the Texas collection had a more prominent stylar beak. The fruits of both collections had walls that were composed of irregularly interlocking cells, each with multilayered, concentric cell walls. The fruit wall separates into nearly equal halves along a cleavage line composed of cells that are not interlocked. The seed coats are composed of flattened cells with annular thickenings and the oblong hypocotyls are composed of large, polygonal cells containing starch grains. The cotyledon and plumule are folded into a hypocotylary invagination along the line of wall separation. A radicle hump or short radicle develops during germination in seawater. Although the taxonomy of Halodule has been based on a vegetative feature, the leaf tips, fruit differences may be of diagnostic value. (Author's abstract)
W87-01090

REMOTE SENSING OF COASTAL WETLANDS,
Scranton Univ., PA. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W87-01093

REPRODUCTION BY GREAT WHITE HERONS ARDEA HERODIAS IN FLORIDA BAY AS AN INDICATOR OF HABITAT QUALITY,
National Audubon Society, Tavernier, FL. Research Dept.
G. V. N. Powell, and A. H. Powell.
Biological Conservation, Vol. 36, No. 2, p 101-113, June 1986. 1 fig, 3 tab, 25 ref.

Descriptors: *Great White Herons, *Florida Bay, *Bioindicators, Reproduction, Habitat quality, Food availability, Anthropogenic effects, History, Monitoring.

Reproduction parameters of great white herons were used to evaluate the habitat quality of eastern Florida Bay. Clutch size and productivity of the herons during three breeding seasons were compared with similar data from 1923, which predated suspected human alteration of the Florida Bay ecosystem. Because about 15% of great white herons nesting in eastern Florida Bay supplemented their diets with food obtained from people, it was possible to evaluate the impact of food availability on reproduction. Herons that fed naturally in Florida Bay (unsupplemented) had significantly smaller clutches and produced significantly fewer fledglings than those of 1923. Herons that received supplemental food had reproductive parameters similar to those of 1923. These data are interpreted as indicating that habitat quality is currently reduced from 1923 levels. The present results support the prediction that wading bird reproduction can be sensitive to habitat quality and that these species should be useful as biological indicators for monitoring habitat quality. (Author's abstract)
W87-01094

GOOSE FAECES: A SOURCE OF NITROGEN FOR PLANT GROWTH IN A GRAZED SALT MARSH,
Toronto Univ. (Ontario). Dept. of Botany.
D. R. Bazely, and R. L. Jeffries.
Journal of Applied Ecology JAPEAI, Vol. 22, No. 3, p 693-703, December 1985. 4 fig, 4 tab, 15 ref.

Descriptors: *Geese, *Feces, *Salt marshes, *Vegetation regrowth, *Nitrogen, Grazing, Marsh plants, Solubility, Ammonia, Nitrogen fixation, Forages.

The influence of goose feces on plant growth at the La Perouse Bay salt marshes in Manitoba, Canada was studied to determine how goose grazing might increase the net above-ground primary production of forage plant species. Addition of fresh feces to experimental plots increased the standing crop as well as the nitrogen content of plant shoots. Fresh feces contained considerable soluble nitrogen, but within 48 hours, the content fell greatly. Except for the period immediately after the hatch of goslings, much of the soluble nitrogen in feces was ammonia. Nitrogen content differed among and between individual droppings. It was determined that geese act on the salt marsh ecosystem by increasing the suuply of available nitrogen for about six weeks each summer. This is sufficient to enhance production of the preferred forage species in a nitrogen-deficient environment. (Michael-PTT)
W87-01125

SURFACE ANALYSIS OF SUSPENDED PARTICLES IN ESTUARINE AND COASTAL WATERS USING X-RAY PHOTOELECTRON SPECTROSCOPY,
Tokyo Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-01137

MEIOFAUNAL PROMINENCE AND BENTHIC SEASONALITY IN A COASTAL MARINE ECOSYSTEM,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
D. T. Rudnick, R. Elmgren, and J. B. Frithsen.
Oecologia (Berlin), OECOBX, Vol. 67, No. 2, p 157-168, September 1985. 3 fig, 6 tab, 85 ref.

Descriptors: Ecosystems, *Benthic fauna, *Seasonal variation, *Coastal waters, *Narragansett Bay, Rhode Island, Marine environment, Population density, Meiofauna, Macrofauna, Organic matter.

The muds of a shallow (7 m) site in Narragansett Bay, Rhode Island contained higher abundances of meiofauna than have been found in any other sediment. These abundances may have occurred because Narragansett Bay sediments are a food-rich environment. While the quantity of organic deposition in the bay is not unusually high for coastal waters, this input, primarily composed of diatom detritus, may contain an unusually proportion of labile organics. Furthermore, meiofauna could have thrived because of spatial segregation of meiofauna and macrofauna. While meiofauna were concentrated at the sediment-water interface, most macrofauna were subsurface deposit feeders. Macrofaunal competition with and ingestion of, meiofauna may thus have been minimized. The seasonal cycles of meiofauna and macrofauna were similar. Highest abundances and biomass were observed in May and June, and lowest values in the late summer and fall. Springtime increases of meiofaunal abundance were observed in all depth horizons to 10cm. The authors hypothesize that phytoplankton detritus accumulated in the sediment during the winter and early spring, and that the benthos responded to this store of food when temperatures rose rapidly in the late spring. By late summer, the stored detritus was exhausted, and the beathos declined. (Doria-PTT)
W87-01143

RECOLONIZATION POTENTIAL OF METRIDIUM SENILE IN AN AREA PREVIOUSLY DEPOPULATED BY OXYGEN DEFICIENCY,
Kiel Univ. (Germany, F.R.). Water Economics and Landscape Ecology Inst.
M. Wahl.
Oecologia (Berlin), OECOBX, Vol. 67, No. 2, p 255-259, September 1985. 4 fig, 1 tab, 13 ref.

Descriptors: *Metridium, *Recolonization, *Population dynamics, *Oxygen depletion, *sea anemones, Fjords, Seasonal variation, Animal populations, Populations, Eutrophication, Flensburg fjord.

Every summer, eutrophication-caused anoxia, lasting a few weeks to several months, eliminates Metridium senile from vast areas of the inner Flensburg fjord. In spring, however, populations of Metridium can be found in these areas, due to intensive recolonization of adult Metridium during autumn and winter. This process was investigated in an 8-month monitoring program in 1981. It was found that Metridium that have detached under oxygen stress form 'drifting populations' and recolonize defaunated areas soon after reoxygenation in autumn. Dry weight analysis shows that the immigrants represent a middle-class of the 'normal' fjord population. The principal limiting factor of recolonization is the lack of (biogenic) substratum, the mollusks having succumbed to anoxia and /or been buried by decaying plankton. Substratum gets rarer with depth and towards the innermost parts of the fjord. Larval colonization does not appear to occur in the fjord. Progressive reduction of organic nutrient input to the fjord could possibly bring about a return to healthy conditions. (Doria-PTT)
W87-01144

INFLUENCE OF RAIN, TIDAL WETTING AND RELATIVE HUMIDITY ON RELEASE OF CARBON DIOXIDE BY STANDING-DEAD SALT-MARSH PLANTS,
For primary bibliographic entry see Field 2I.
W87-01147

QUANTITATIVE COMPARISON OF MICROBIAL COMMUNITY STRUCTURE OF ESTUARINE SEDIMENTS FROM MICROCOSMS AND THE FIELD,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
T. W. Federle, R. J. Livingston, L. E. Wolfe, and D. C. White.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 4, p 319-325, April 1986. 5 fig, 1 tab, 37 ref.

Descriptors: *Microorganisms, *Estuarine environment, *Sediments, *Ecosystems, *Ecological distribution, *Species diversity, Predation, Fatty acids, Environment, Estuaries.

Estuarine soft-bottom sediments in microcosms and the field were compared with regard to microbial community structure. Community structure was determined by analyzing the fatty acids derived from the microbial lipids in the sediments. Fatty acid profiles were compared using a multivariate statistical approach. The community structure of St. George Sound, Florida sediments was apparently controlled by epibenthic predators. In Apalachicola Bay, Florida, the dominant influences were physical factors related to the flow of the Apalachicola River. In the St. George Sound experiment, microbial communities in the microcosms differed from those in the field after only two weeks, and the degree of this difference increased substantially as time progressed. In the Apalachicola Bay experiment, although microbial communities in the microcosms were detectably different from those in the field, the degree of this difference was not large nor did it increase with time. This differential behavior of sediment communities from different sites may be related to the different ecological factors regulating community composition at these sites. (Author's abstract)
W87-01161

SEASONAL CHANGES IN MOVEMENTS, ABUNDANCE, SIZE COMPOSITION AND DIVERSITY OF THE FISH FAUNA OF THE SEVERN ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
P. N. Claridge, I. C. Potter, and M. W. Hardisty.
Marine Biological Association of the United Kingdom Journal JMBAAK, Vol. 66, No. 1, p 229-258, February 1986. 7 fig, 3 tab, 110 ref.

Descriptors: *Seasonal distribution, *Species diversity, *Population density, *Fish, *Severn Estuary, *Estuaries, Estuarine environment, Density, Distribution, Aquatic animals, Environment.

Extensive sampling of the intake screens of power stations in the Severn Estuary and Bristol Channel yielded 97 species of lampreys, elasmobranchs, and teleosts. The number of species, and to an even greater extent the total number of fish, underwent consistent seasonal trends, with maximum and minimum values for the latter occurring between September and January and between March and May, respectively. The seasonal trends for species richness, Shannon-Wiener and Evenness indices were similar, with maximum and minimum values generally occurring in the winter and summer, respectively. A comparison between the authors' data and those of earlier workers indicates that no major change has occurred in the composition of the fish fauna of the Severn Estuary during this century, except for the establishment of two 'northern' species, northern rockling (Ciliata septentrionalis) and Norway pout (Trisopterus esmarkii) during recent times. (Author's abstract)
W87-01165

ONE-DIMENSIONAL MODEL FOR SALINITY INTRUSION IN ALLUVIAL ESTUARIES,
Euroconsult, Arnhem (Netherlands).
H. H. G. Savenije.
Journal of Hydrology JHYDA7, Vol. 85, No. 12, p 87-109, June 15, 1986. 17 fig, 2 tab, 6 ref.

Descriptors: *Saline water intrusion, *Model studies, *Estuaries, *Alluvial deposits, *Estimating equations, *Salinity, *Solute transport, Estimating, Chemical properties, Water depth, Tides, Tidal prism, Hydraulics.

A salinity intrusion model has been developed for well-mixed alluvial estuaries. The parameters are schematized in such a way that the amount of field work in gathering data on estuary geometry and tide is considerably reduced. The determing factor in the geometry is found to be the variation of width in the estuary; this relationship appears to obey an exponential law. The depth is found to remain fairly constant and need not be measured. A stationary and a non-stationary model are developed. The stationary model may be applied using a pocket calculator. In many cases where the stationary model may not be used, the non-stationary model may be applied. Application of the model is demonstrated on several alluvial estuaries. (Author's abstract)
W87-01182

EFFECT OF SALINITY-DEPENDENT HYDRAULIC CONDUCTIVITY ON SALTWATER INTRUSION EPISODES,
Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 2F.
W87-01191

EFFECTS AND IMPLICATION OF TIDES AND RAINFALL ON THE CIRCULATION OF WATER WITHIN SALT MARSH SEDIMENTS,
Institute of Oceanographic Sciences, Taunton (England).
A. P. Carr, and M. W. L. Blackley.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 266-176, March 1986. 6 fig, 3 tab, 19 ref.

Descriptors: *Groundwater movement, *Estuaries, *Marshes, *Water circulation, *Sediments, *Tidal effects, *Rainfall, *Water table fluctuations,Salt marshes, Ravenglass Estuary, England.

The response of the water table of an intertidal salt marsh in northwestern England has been investigated. During neap tides, water seeps upward from the underlying sand-silt-clay interface. This effect continues as the marsh is overtopped during spring tides but is then dwarfed by penetration of water downward from the surface. Under typical conditions the delay between high water in the river and maximum apparent water level for the marsh becomes less as the spring-tide cycle maximum is approached. Lags also appear smaller during summer, probably mainly due to dessication cracks. Precipitation effects are only important when rainfall is significant in quantity and coincides with low water during neap tides. (Author's abstract)
W87-01227

OXYGEN PRODUCTION AND COMSUMPTION IN SEDIMENTS DETERMINED AT HIGH SPATIAL RESOLUTION BY COMPUTER SIMULATION OF OXYGEN MICROELECTRODE DATA,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
N. P. Revsbech, B. Madsen, and B. B. Jorgensen.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 293-304, March 1986. 9 fig, 2 tab, 25 ref. Carlsburg Foundation Grants 1981/82 114/IV, 1983/84 124/IV.

Descriptors: *Estuaries, *Sediments, *Fjords, *Photosynthesis, *Oxygen requirements, Limfjorden, Denmark, Computer models.

Microprofiles of oxygen and oxygenic photosynthesis were measured in a photosynthetically active sediment by an oxygen microelectrode. The diffusion coefficient of oxygen in the uppermost 1 mm of the sediment was determined in poisoned sediment by microelectrode measurement of changes in the oxygen profile during nonsteady state conditions. The experimentally obtained data were inserted into computer models to calculate the vertical profile of the oxygen comsumption rate. The calculations showed that the rate of oxygen consumption was highest at the oxic-anoxic bondary where sulfide was oxidized and in the lowest part of the photic zone. Computer models were also used to obtain more accurate profiles of oxygen production. The oxygen profiles calculated by the computer were very close to those obtained experimentally both during the steady state developed under light and during the transient conditions developed at the onset darkness. (Author's abstract)
W87-01229

METABOLIC REGULATION OF AMINO ACID UPTAKE IN MARINE WATERS,
Georgia Univ., Athens. Dept. of Microbiology.
D. L. Kirchman, and R. E. Hodson.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 339-350, March 1986. 7 fig, 3 tab, 21 ref. NSF Grants OCE 81-17834, OCE 84-16384; NOAA Sea Grant NA 80AA-D-0091.

Descriptors: *Estuaries, *Amino acids, *Metabolism, *Bacteria, Marine bacteria, Mineralization, Nitrogen, Organic nitrogen, Proteins.

The uptake of dipeptides and free amino acids by bacterial assemblages of estuarine and coastal waters of the southeast U.S. was studied to determine the relationships among the processes of uptake, intracellular pool formation, and incorporation of amino acids into protein. The dipeptide phenylalanyl phenylalanine (phe-phe) lowered the maximum phenylalanine uptake rate when the turnover rate of phenylalanine was relatively high. At a low turnover rate the phe-phe either had no effect or increased the maximum uptake of phenylalanine. To measure the turnover time of the intracellular pool of phenylalanine, an analytical model was developed. When phe-phe was not added, the turnover time of the intracellular pool was 0.89 min. Addition of 1.0 nM phe-phe increased the turnover time of the pool to 3.8 min in waters where phe-phe lowered the maximum phenylalanine uptake rate. These results suggested that the size of the intracellular pool is regulated, which precludes high assimilation rates of both phenylalanine and phe-phe. In waters with relatively low phenylalanine turnover rates, bacterial populations apparently have the ability to assimilate phenylalanine and phe-phe simultaneously. Marine bacterial assemblages do not substantially increase the apparent respiration of amino acids when concentrations increase. Sustained increases in uptake rates and mineralization by marine bacterial assemblages in response to an increase in the concentration of dissolved organic nitrogen is determined by the rate of protein synthesis. (Author's abstract)
W87-01231

INVESTIGATIONS OF THE MARINE ALGAE OF NOVA SCOTIA. XVI. THE OCCURRENCE OF SMALL GREEN ALGAE,
Copenhagen Univ., Frederikshavn (Denmark). Afd. Havbiologisk.
R. Nielsen, and J. McLachlan.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 4, p 808-814, April 1986. 9 fig, 2 tab, 35 ref.

Descriptors: *Estuaries, *Algae, *Chlorophyta, Nova Scotia, Prince Edward Island, Benthic flora, Marine algae, Acrochaetes.

Small green benthic marine algae were collected at 26 sites in Nova Scotia and Prince Edward Island in 1982. Host materials included other algae, plants, animals, wood shavings, and small stones. Twenty species, distributed in 14 genera, were identified. Tellamia contortata Batters was reported for the first time in the maritime provinces. Six other species were new records for eastern Canada: Acrochaete leptochaete (Huber) R. Nielsen, Blastophysa rhizopus Reinke, Endophyton ramosum Gardner, Phaeophila tenuis (Kylin) R. Nielsen, Pseudendeclonium dynamenae R. Nielsen, and Syncoryne reinkei R. Nielsen and Pedersen. (Cassar-PTT)
W87-01236

QUANTITATIVE COMPARISON OF MICROBIAL COMMUNITY STRUCTURE OF ESTUARINE SEDIMENTS FROM MICROCOSMS AND THE FIELD,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
T. W. Federle, R. J. Livingston, L. E. Wolfe, and D. C. White.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 4, p 319-325, April 1986. 5 fig, 1 tab, 37 ref. EPA Contract CR810292-02.

Descriptors: *Estuaries, *Microorganisms, *Sediments, Aquatic habitats, Habitats, Apalachicola Bay, Florida, St. George Sound, Predation, Fatty acids.

Estuarine soft-bottom sediments in microcosms and the field were compared with regard to microbial community structure. Community structure was determined by analyzing the fatty acids derived from the microbial lipids in the sediments. Fatty acid profiles were compared using a multivariate statistical approach. Experiments were performed using sediments from St. George Sound and Apalachicola Bay, Florida. The community structure of St. George Sound sediments was apparently controlled by epibenthic predators. In Apalachicola Bay, the dominant influences were physical factors related to the flow of the Apalachicola River. In the St. George Sound experiment, microbial communities in the microcosms differed from those in the field after only two weeks, and the degree of this difference increased substantially as time progressed. In the Apalachicola Bay experiment, although microbial communities in the microcosms were detectably different from those in the field, the degree of this difference was not large nor did it increase with time. This differential behavior of sediment communities from different sites may be related to the different ecological factors regulating community composition at these sites. (Author's abstract)
W87-01242

SHALLOW-WATER BENTHIC AND PELAGIC METABOLISM: EVIDENCE OF HETEROTROPHY IN THE NEARSHORE GEORGIA BIGHT,
Georgia Univ., Sapelo Island. Marine Inst.
C. S. Hopkinson Jr.
Marine Biology MBIOAJ, Vol. 87, No. 1, p 19-32, June 1985. 12 fig, 3 tab, 83 ref.

Descriptors: *Estuaries, *Benthos, *Metabolism, *Organic carbon, *Respiration, Oxygen uptake, Seasonal variation, Water column, Biodegradation, Primary productivity, Macrophytes, Georgia Bight.

Pelagic primary production and benthic and pelagic aerobic metabolism were measured monthly at one site in the estuarine plume region of the nearshore continental shelf in the Georgia Bight. Average respiratory quotients were 1.18:1 and 1.02:1 for the benthos and water column, respectively. Benthic oxygen uptake ranged from 1.23 to 3.41 g 02/sq m/day and totalled 756 g 02/sq m over an annual period. Water column respiration accounted for 60% of total system metabolism. Turnover rates of organic carbon in sediment and the water column were 0.09 to 0.18/yr and 6.2/yr, respectively. Resuspension appeared to control the relative amounts of organic carbon, as well as the sites and rates of organic matter degradation in the benthos and water column. Most of the seasonal variation in benthic and pelagic respiration could be explained primarily by temperature and secondarily by primary productivity. The .timing of the heterotrophic periods through the year appeared to be closely related to both river discharge and the periodicity of growth and death of marsh macrophytes in the adjacent estuary. These results support the estuarine outwelling hypotheses of Odum (1986). (Author's abstract)
W87-01276

BRANCHIAL NA(+)-K(+)-ATPASE ACTIVITY DURING OSMOTIC ADJUSTMENTS IN TWO FRESHWATER EURYHALINE TELEOSTS, TILAPIA (SAROTHERODON MOSSAMBICUS) AND ORANGE CHROMID (ETROPLUS MACULATUS),
Wilson Coll., Bombay (India). Dept. of Zoology.
A. D. Dange.
Marine Biology MBIOAJ, Vol. 87, No. 1, p 101-107, June 1985. 8 tab, 21 ref.

Descriptors: *Fish, *Ecological effects, *Salinity, *Enzymes, *Salt tolerance, Saline water, Water pollution effects, Osmotic pressure, Salt balance, Seawater, Tilapia, Cichlid.

The effects of four different regimes of external salinity changes on branchial Na(+)-K(+)-ATPase activity was studied in tilapia and orange chromid fish. The four regimes were: sudden exposure to salt water of various strengths; gradual acclimation to high salinities; acclimation to identical concentrations of NaCl or whole ocean salt; and reacclimation to freshwater. Direct transfer of tilapia from freshwater to salt water of relatively higher strengths stimulated the activity of branchial Na(+)-K(+)-ATPase during the first week of acclimation, without any more significant change in following weeks. All the selected saltwater concentrations which did not affect the survival rate produced a remarkably significant rise in the enzyme activity in orange chromid. Both tilapia and orange chromid could be adapted to higher salinity levels by gradual acclimation. The changes in enzyme activity induced by this process were less extensive than those elicited by direct transfer. The stress created by transfer to pure NaCl solution was more effective than that produced by whole ocean saltwater of the same concentration in inducing the enzyme response in tilapia but not in orange chromid. Transfer of saltwater-adapted fish of both species to freshwater led to a reduction in enzyme activity which generally remained above the normal freshwater levels even after 8 weeks of reacclimation. (Geiger-PTT)
W87-01277

DEVELOPMENT OF EPIPHYTIC COMMUNITIES ON EELGRASS (ZOSTERA MARINA) ALONG A NUTRIENT GRADIENT IN A DANISH ESTUARY,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
J. Borum.
Marine Biology MBIOAJ, Vol. 87, No. 2, p 211-218, July 1985. 7 fig, 2 tab, 28 ref.

Descriptors: *Nutrients, *Estuaries, *Seasonal variation, *Sea grasses, *Epiphytes, Biomass, Aquatic populations, Nitrogen, Phytoplankton, Aquatic productivity, Denmark, Roskilde Fjord.

The effect of nutrient enrichment on epiphyte development was examined by following the seasonal development of epiphyte biomass on eelgrass (Zostera marina L.) at four localities along a nutrient gradient in Roskilde Fjord, Denmark between March and December 1982. In the most nutrient-poor area, epiphyte biomass followed a distinct bimodal seasonal pattern with maxima in spring and early fall. Low nutrient availability and a high rate of eelgrass leaf renewal kept epiphyte biomass at a low level throughout the summer period. Unlike phytoplankton, the epiphytic community was not stimulated by nutrient enrichment during spring. However, from May through August, the biomass of both components increased exponentially with increasing concentrations of total N in the water. Along the nutrient gradient, phytoplankton biomass increased 5- to 10-fold, while epiphyte biomass increased 50- to 100-fold. Thus differences in nutrient conditions among study sites were more clearly reflected by epiphytes than phytoplankton. (Author's abstract)
W87-01279

INFLUENCE OF QUANTITATIVE AND QUALITATIVE ASPECTS OF HABITAT COMPLEXITY IN TROPICAL SEA-GRASS MEADOWS,
Harbor Branch Inst., Inc., Fort Pierce, FL.
A. W. Stoner, and F. G. Lewis III.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 19-40, December 1985. 4 fig, 5 tab, 50 ref, append.

Descriptors: *Sea grasses, *Aquatic habitats, *Crustaceans, *Macrophytes, *Biomass, Population density, Aquatic populations, Species diversity, Meadows, Tropical regions, Venezuela, Islas Los Rogues.

In sea-grass meadows of Islas Los Rogues, Venezuela, densities of turtle grass (Thalassia testudinum) and the understory of calcareous green algae (Halimeda opuntia) were manipulated in nine experimental treatments and controls to examine the effect of both quantitative (biomass and total surface area) and qualitative (architectural) aspects of habitat complexity on crustacean assemblages. The greatest abundance of crustaceans occurred in plots with highest macrophyte biomass. The number of individuals per unit plant surface area was uniform over all vegetated treatments, suggesting that surface area of the habitat controlled total abundance of epifaunal crustaceans, regardless of architectural type available. The highest species richness was found in treatments containing high standing crops of Thalassia and Halimeda, suggesting that quantitative aspects of habitat complexity have an important effect on species richness. Responses of individual species to architectural type varied; of the 15 most abundant taxa, eight species were significantly associated with Halimeda, while only two were associated with Thalassia. Because of the high number of animal species associated with Halimeda, addition of this architectural type to Thalassia beds had a pronounced effect on faunal species richness in the grass beds. It was concluded that both quantitative and qualitative aspects of habitat complexity affect abundance, species richness, and composition of crustaceans in tropical sea-grass meadows. (Geiger-PTT)
W87-01281

COMPOSITION, ABUNDANCE, AND PHENOLOGY OF FOLIOSE RED ALGAE ASSOCIATED WITH TWO CENTRAL CALIFORNIA KELP FORESTS,
Moss Landing Marine Labs., CA.
V. A. Breda, and M. S. Foster.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, December 1985. 5 fig, 4 tab, 42 ref.

Descriptors: *Species composition, *Rhodophyta, *Algae, *Kelps, *Biomass, Macrophytes, Aquatic populations, Species diversity.

Seasonal variations in biomass and reproductive phenology of red algae were studied in two central California kelp forests with different physical environments. At each site, random 0.25-sq m samples of foliose red algae were collected monthly and biomass (g dry weight) and reproductive condition recorded for each species. At the more protected, rocky site, the perennials Botryocladia pseudodichotoma (Farl.)Kyl., Gigartina corymbifera (Kutz.) J. Ag., and Rhodymenia californica var. californica Kyl. were most abundant. At the more exposed site with moving sand, both perennials (Gigartina corymbifera and Rhodymenia pacifica Kyl.) and annuals such as Polyneura latissima (Harv.) Kyl., Phycodrys setchellii Skottsb., and Nienburgia andersoniana (J. Ag.) Kyl. were abundant. At both sites, the biomass of female and tetrasporic plants was generally very low relative to the total biomass. Reproductive plants at the protected site occurred from March to October whereas various species were reproductive at different times during the year at the exposed site. Several interacting factors appear to regulate red algal composition and abundance in these kelp forests. Overstory development, lack of disturbance, and invertebrate overgrowth seems most important at the protected site whereas physical disturbance in the form of sand and water movement appear to be more important at the exposed site. (Author's abstract)
W87-01282

WATER RELATIONS AND OSMOREGULATION OF THE BEACH-HOPPER ORCHESTIA GAMMARELLUS (PALLAS) (CRUSTACEA: AMPHIPODA),
University Marine Biological Station, Millport (Scotland).
P. G. Moore, and C. H. Francis.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 131-150, December 1985. 11 fig, 4 tab, 51 ref.

Descriptors: *Crustaceans, *Salt tolerance, *Habitats, *Osmoregulation, *Water loss, Saline water, Amphipods, Clyde Sea.

The ecophysiology of the supralittoral Orchestia gammarellus (Pallas) is discussed in relation to the colonizaion of terrestrial habitats by talitrid amphipods. In situ recordings of temperature and humidity conditions beneath supralittoral wrack piles in the Clyde Sea area are presented for summer and winter periods. Wrack piles insulate the substratum from extreme temperatures and maintain near saturated humidities irrespective of time of day. At relative humidities below 80%.0. gammarellus dies after <10 hr at ambient summer temperatures. Water loss of live and dead 0. gammarellus is equivalent with no active mechanism for water retention in living animals. Small animals and actively moving animals lose water fastest. At a particular relative humidity, water loss is temperature dependent, being related to saturation deficit. Some water may be lost over the entire body surface. High densities of cuticular pores which might conduct water were found on the body surface using scanning electron microscopy, and one type appears to be associated with the secretion of epicuticular waxy material, one component of which melts at approximately 36-44 C. Weight fluxes (in either direction) beyond approximately 17% of body weight are intolerable: this represents + or - 25% of total body water content. Water is lost during desiccation at the expense of the haemolymph. Short-term loss is made good internally probably by mobilizing water from the gut. 0. gammarellus is capable of hyper/hypo-osmoregulation when fed food of different salt content. Its osmoregulatory pattern when immersed in waters of different salinity is rather variable, however, and may reflect the foreignness of these conditions. (Author's abstract)
W87-01283

MODULATION OF NAEMOCYANIN OXYGEN AFFINITY IN THE PRAWN, PALAEMON ELEGANS (RATHKE) UNDER ENVIRONMENTAL SALINITY STRESS,
Glasgow Univ. (Scotland). Dept. of Zoology.
A. C. Taylor, S. Morris, and C. R. Bridges.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 167-180, December 1985. 5 fig, 1 tab, 36 ref. NERC Grant Gr3/5311, Deutsche Forschungsgemeinschaft Gr456/10-7.

Descriptors: *Respiration, *Shrimp, *Saline water, *Salt tolerance, *Blood, Crustaceans, Oxygen uptake, Ecology, Coastal waters, Physiological ecology.

The effects of salinity acclimation on the oxygen-transporting properties of the blood of the intertidal prawn Palaemon elegans (Rathke) were studied in laboratory aquariums. Although there was considerable variation in the haemocyanin content of the haemolymph between individual animals, an inverse relationship was obtained between the haemocyanin content of the blood and the salinity to which the animals were acclimated. This resulted in an increase in the oxygen-carring capacity of the haemocyanin from 1.2 millimoles/liter to 1.48 millimoles/liter in prawns acclimated to salinities of 30 and 10 parts per thousand, respectively. No significant differences were observed in either the oxygen affinity or in the size of the Bohr effect of the haemocyanin in animals maintained in salinities of 10, 20, and 30 parts per thousand, but blood from animals kept in water having a salinity of 40 parts per thousand had both a higher oxygen affinity and a higher Bohr value. These increases were due primarily to changes in the concentration of ions, mainly Mg(2+), in the blood of these animals. The co-operativity of the haemocyanin did not differ significantly between the four test groups of prawns. In addition, the effect of L-lactate on the modulation of haemocyanin oxygen affinity was unaffected by changes in the ionic composition of the blood associated with acclimation to differing salinities. (Author's abstract)
W87-01284

GROWTH OF DARK-EXPOSED LAMINARIA SACCHARINA (L.) LAMOUR. AND LAMINARIA SOLIDUNGULA J. AG. (LAMINARIALES: PHAEOPHYTA) IN THE ALASKAN BEAUFORT SEA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
K. M. Dunton.
Journal of Experimental Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 181-189, December 1985. 2 fig, 24 ref.

Descriptors: *Algae, *Kelps, *Marine algae, *Plant growth, *Arctic zone, Polar regions, Ice cover, Arctic, Sea ice, Beaufort Sea.

Linear growth of Laminaria saccharina (L.) Lamour. and L. solidungula J. Ag. sporophytes exposed for 9 months of darkness under a turbid ice canopy were compared over a 2-yr period in the Alaskan Beaufort Sea. Peak growth in L. solidungula (1.4 mm/day) occurred from late February to late April. Maximum growth in L. saccharina (4.7 mm/day) was recorded between late April and late July. Since the dark period extends from about November to June, L. solidungula completed most of its growth in complete darkness. During the dark period, from November to late April, linear growth was 1.5 to 8 times greater than that of L. saccharina. In contrast, L. saccharina completed nearly all of its annual growth during the period when light first starts to penetrate the water column as a result of breakup of the ice canopy. The period of rapid growth in L. saccharina occurs 4 to 5 months later than plants found at temperate latitudes. The seasonal pattern of linear growth in the two species differs because L. saccharina does not appear to depend on stored carbon reserves for winter and spring growth. The delay of growth in the ubiquitous L. saccharina to late spring reflects a different growth strategy than that found in L. solidungula. (Author's abstract)
W87-01285

PHOTOSYNTHETIC AND CELLULAR PHOTOADAPTIVE CHARACTERISTICS OF THREE ECOTYPES OF THE MARINE DIATOM, SKELETONEMA COSTATUM (GREV.) CLEVE,
City Coll., New York. Dept. of Biology.
J. C. Gallagher, and R. S. Alberte.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 233-250, December 1985. 4 fig, 4 tab, 35 ref. NSF Grants DEB 80-21744, PCM78-10535, OCE82-14914; CUNY Research Foundation Grant 664134.

Descriptors: *Diatoms, *Photosynthesis, *Respiration, *Marine algae, *Light intensity, Chrysophyta, Light penetration, Bays, Ecosystems, Seasonal variation, Narragansett Bay.

Physiological variation among genetically distinct clones of Skeletonema costatum (Grev.) Cleve, representative of the prevalent seasonal populations of this species in Narragansett Bay, were examined to determine the nature of their optimal survival strategies in response to changes in light intensity. The clones were found to exhibit significant differences in growth rates, cellular pigment content, PSU-RCI and PSU-RCII numbers per cell, ratios of RCI/RCII and photosynthetic capacities per cell. Respiration rates and I sub c values did not vary among clones. The variation among clones for many characteristics was similar in magnitude to those previously reported for differences among species. No single photosynthetic feature dominated or predicted the photoadaptive mechanism in any clone examined. Large clonal differences in photoadaptive features suggest that the evolution of the seasonal ecotypes of S. costatum was not a recent phenomenon. The integration of cell-dependent and cell-independent photosynthetic features in each clone and, by inference, the genetic groups which they represent, partially accounts for the seasonal pattern of abundance distinct allochronic populations in the Narragansett Bay ecosystem. (Author's abstract)
W87-01286

INFLUENCE OF DURATION-OF-INUNDATION OF DEVELOPMENT OF A MAN-INITIATED SPARTINA ALTERNIFLORA LOISEL. MARSH IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Botany.
E. D. Seneca, S. W. Broome, and W. W. Woodhouse Jr.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No, 1-3, p 259-268, December 1985. 1 fig, 3 tab, 15 ref. Army Corp of Engineers Contract. DACW72-72-C-0012, GH-103.

Descriptors: *Marshes, *Marsh plants, *Tidal marshes, *Plant growth, *Spartina, Species compostion, Flooding, Species diversity, North Carolina, Standing crop.

The relative growth responses of a man-made Spartina alterniflora Loisel. marsh were monitored annually in four duration-of-inundation zones (4,7,9, and 11 hr daily) during a 4-yr period following the 17-mo establishment period, with another sampling 10 yrs later. There was a general trend of maximum values for height, number of flowers/sq m, basal area, and aboveground standing crop to occur in the 7-hr inundation zone and for these values to decrease in the 9- and 11-hr zones at the end of the second growing season (17 mo after planting). This trend was reversed from the third through the fifth growing seasons with height, number of flowers/sq m, and aboveground standing crop significantly higher in the longest inundation zone. The aboveground standing crop of S. alterniflora-dominated 11-hr inundation zone became stabilized by the third growing season, but the belowground material dry weight continued to increase in all zones through the fifth season when its rate of accumulation began to stabilize in the lowermost zones. The number of invading species present in the fifth season decreased by >65% in the twelfth season, but the remaining invaders generally constituted relatively more of the aboveground standing crop by the twelfth season. Over the 12 seasons, the experimental S. alterniflora planting developed into a marsh with species composition dictated by the availability of disseminules of other angiosperms under the prevailing environmental conditions of duration-of-inundation and salinity. (Author's abstract)
W87-01287

FEEDING IN INTERTIDAL ACARI,
University Coll. of Swansea (Wales). School of Biological Sciences.
P. J. A. Pugh, and P. K. King.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 269-280, December 1985. 2 fig, 5 tab, 34 ref.

Descriptors: *Acari, *Marine animals, *Food habits, *Behavior, Food chains, Aquatic animals, Intertidal areas, Littoral zone, Predation.

The feeding habits of some British intertidal Acari were examined in laboratory experiments and compared to the feeding patterns in the aquatic (halacarid) and terrestrial (non-halacarid) moieties of the fauna. A modified vertical polyacrylamide gel and an esterase stain were used to study predator-prey interactions among Acari. Results suggested that there are two different feeding adaptations among the intertidal Acari: the highly adapted Nalacaridae, Ameronothridae and Nyadesidae which feed upon typically marine materials, such as intertidal algal microphytes or other marine microarthropods, and the remaining majority of Acari which feed upon typically terrestrial material such as nematodes, oligochaetes, and insects, similar to that consumed by their soil and leaf litter-inhabiting counterparts. This division into two groups, based upon physiological and morphologiccal specializations as suggested in related studies is reflected in the diets of the two groups. Other feeding adaptations to the littoral environment included endurance of starvation (a pre-adaptation), and synchrony of feeding with the tidal cycle (a specialization). (Geiger-PTT)
W87-01288

PARTIAL PURIFICATION AND CHARACTERIZATION OF ALANINE RACEMASE FROM THE BRACKISH-WATER BIVALVE CORBICULA JAPONICA,
Hiroshima Univ. (Japan). Zoological Inst.
Y. Omura, Y. S. Hayashi, O. Matsushima, H. Katayama, and K. Yamada.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 94, No. 1-3, p 281-289, December 1985. 6 fig, 1 tab, 18 ref.

Descriptors: *Mollusks, *Animal physiology, *Enzymes, *Amino acids, Brackish water, Separation techniques, Osmoregulation.

Alanine racemase from the foot muscle of the brackish-water bivalve Corbicula japonica was partially purified by ammonium sulfate fractionation, ion exchange chromatography and gel filtration. The molecular weight of the enzyme was estimated as 130000 by gel filtration on Bio-Gel A-1.5m. The ph optimum was 9.0-9.5 in the L-alanine-to-D-alanine direction and 8.5-9.0 in the D-to-L direction. The apparent Michaelis-Menton constant value for L-alanine was 110 mM and that for D-alanine was 38mM. Some compounds, which have been known as inhibitors of bacterial alanine racemase, were examined for their inhibitory effects on the bivalve enzyme. Alanine racemase seems to play a signficant role in racemization of alanine which is the chief component of the free amino acid pool in relation to intracellular osmoregulation. (Author's abstract)
W87-01289

DISSOLVED FULVIC ACIDS FROM THE NEAR CONTINENTAL SHELF. RELATION TO ESTUARIES, (LES ACIDES FULVIQUES DISSOUS DANS LES EAUX DU PROCHE PLATEAU CONTINENTAL. RELATION AVEC LA SITUATION ESTUAIRIENNE),
Bordeaux-1 Univ., Talence (France). Groupe d'Oceanographie Physicochimique.
P. Berger, C. Belin, M. P. Marniesse, and M. Ewald.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 301, No. 11, p 801-806, October 10 1985. 3 fig, 1 tab, 13 ref.

Descriptors: *Dissolved solids, *Fulvic acids, *Fluorescence, *Continental shelf, Organic carbon, Humic acids, Estuaries.

The fluorescence intensity associated with dissolved fulvic acids decreases as one goes from the coast to the sea; so do the absorbances and concentrations of dissolved organic carbon. The very low

fluorescence intensities recorded for the marine samples prevents precise determination of the position of the emission maximum. After concentration over an ultrafiltration membrane (threshhold 1000 molecular weight), fulvic acids from the near continental shelf emit fluorescence spectra similar to that of terrigenic fulvic acids. This supports the hypothesis that fluorescent material of the near continental shelf is of continental origin. (Airone-PTT)
W87-01345

ENERGY OF SEA WIND WAVES AND PRINCIPLES OF ITS CONVERSION,
For primary bibliographic entry see Field 2H.
W87-01379

DEMISE OF MEROMIXIS IN RIVERINE LAKES OF THE WORLD HERITAGE WILDERNESS OF SOUTH-WEST TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W87-01458

PROTECTING THE CHESAPEAKE BAY: MARYLAND'S CRITICAL AREA PROGRAM,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
For primary bibliographic entry see Field 5G.
W87-01503

MERCURY DISTRIBUTION IN A POLLUTED MARINE AREA, RATIO OF TOTAL MERCURY, METHYL MERCURY AND SELENIUM IN SEDIMENTS, MUSSELS AND FISH,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5B.
W87-01552

MODIFICATION OF AN ESTUARY,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5C.
W87-01578

NITROGEN FIXATION (ACETYLENE REDUCTION) IN PLANKTIC CYANOBACTERIA IN OREGRUNDSGREPEN, SW BOTHNIAN SEA,
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
G. Lindahl, and K. Wallstrom.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 193-204, August 1985. 4 fig, 26 ref.

Descriptors: *Nitrogen fixation, *Acetylene, *Cyanobacteria, *Oregrundsgrepen, *Bothnian Sea, Biomass, Phytoplankton, Heterocysts, Primary productivity.

Nitrogen fixation (acetylene reduction) was measured in a coastal area of the SW Bothnian Sea, the Baltic, during 1977 and 1978. The following parameters of the nitrogen fixing population were studied: species composition, biomass, number of heterocysts, heterocyst frequency, heterocyst activity and the acetylene reduction. The dominating species was Aphanizomenon flos-aquae which, as a mean, had 35,000,000 heterocysts/sq m, and a heterocyst frequency ranging between 0.5 and 2.3 heterocysts/mm filament. The mean heterocyst activity, which expresses the nitrogen fixation capacity of the population, was 1332 nmol C2H4 times 10 to the -7th power/heterocyst/h in 1977 and 1880 nmol in 1978. The nitrogen fixation was calculated to 0.06 g N/sq m/yr both years, which corresponded to only 1% of the nitrogen requirement for the primary production during the summer. The levels of the nitrogen fixation parameters studied as well as the significance of nitrogen fixation for primary production were lower in Oregrundsgrepen than in the northern Baltic Proper. (Author's abstract)
W87-01605

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION: THE SOLUTION TO OMAN'S THIRST,
Ministry of Electricity and Water, Muscat (Oman).
A. A. Dawood, and R. W. Leidholdt.
American Water Works Association Journal JAWWA5, Vol. 78, No. 7, p 80-85, July 1986. 3 fig, 2 tab.

Descriptors: *Oman, *Desalination, *Urban areas, *Seawater, Multiflash distillation, Desalination plants, Electric power production, Management planning, Muscat, Water treatment facilities, Water supply systems.

The Sultanate of Oman, which has limited oil and water resources, is coping with the twin problems of rapid modernization and severely limited freshwater supplies by using multiflash distillation of seawater in conjunction with electrical power generation. The history of the Sultanate's water system, water sources, transmission facilities, distribution system, production and consumption, and future plans are described. The water system for the greater Muscat (the capital city) area has had serious growing pains in the past 5 yr, but with improvements in management, operations and maintenance, training of additional Omani personnel, and proper planning through computer modeling, an orderly expansion of a reliable supply system is anticipated. (Rochester-PTT)
W87-01024

ABU DHABI SOLAR DISTILLATION PLANT,
Water and Electricity Dept., Abu Dhabi (United Arab Emirates).
A. M. El-Nashar, and K. Iishi.
Desalination, Vol. 52, No. 3, p 214-234, August 1985. 12 fig, 5 tab, 10 ref.

Descriptors: *Desalination, *Abu Dhabi, *Solar distillation, Solar stills, Thermal stratification, Design criteria, Evaporators, Automation, Simluation.

A small solar desalination plant designed and constructed as part of a cooperative research program between Abu Dhabi and Japan is described. The system uses a horizontal tube, thin-film, multieffect stack distillation concept and has a design capacity of 120 cubic meters per day. Solar energy is provided by a bank of evacuated glass tube collectors which cover an area of 1862 square meters. Three thermally stratified vertical thermal storage tanks are used to provide thermal energy for the distiller. The plant is designed for continuous, 24-hours per day operation. The results of two preliminary performance simulation models are also presented. (Michael-PTT)
W87-01100

INFLUENCE OF MEMBRANE HETEROGENEITY ON THE SOLUTE RETENTION,
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
J. Van Daalen, and J. A. M. Smit.
Desalination, Vol. 52, No. 3, p 235-247, August 1985. 3 fig, 1 tab, 19 ref.

Descriptors: *Reverse osmosis, *Mathematical equations, *Filtration, *Membrane processes, *Solutes, *Retention, *Cellulose acetate membranes, *Calcium chloride, Solute transport, Permeability, Statistical methods, Volumetric analysis.

A Spiegler-Kedem type expression for retention as a function of volume flow is derived for heterogeneous membranes. Linearization of the expression yields an equation by which reverse osmosis experiments can be analyzed and the reflection coefficient and solute permeability and their ratio can be determined. The relation between retention and volume flow is discussed and results are specified for cellulose acetate membranes and calcium chloride solutions. The linear equation is compared with other known linear equations and some reverse osmosis experiments are reanalyzed. (Author's abstract)
W87-01101

OPTIMISATION OF MEMBRANE MODULE DESIGN FOR BRACKISH WATER DESALINATION,
New South Wales Univ., Kensington (Australia). School of Chemical Engineering.
D. E. Wiley, C. J. D. Fell, and A. G. Fane.
Desalination, Vol. 52, No. 3, p 249-265, August 1985. 5 fig, 3 tab, 24 ref.

Descriptors: *Desalination, *Brackish water, *Membrane processes, *Design criteria, *Reverse osmosis, *Cost analysis, *Computer models, Mass transfer, Mathematical equations, Energy conservation, Permeability.

A study was made of the optimization of membrane modules for brackish water desalination. Particular attention was paid to energy efficiency by designing the flow channels so that back diffusion of solute was enhanced but did not jeopardize effective transmembrane pressure. Spiral wound, tubular and flat plate commercial designs were evaluated in terms of unit membrane and unit power costs. Optimum module design was found to one where channel height is small and flow path length and cross flow are held low. Although the spiral wound module appeared to be closest to an optimal design, there seems to be room for improvement in the design of existing commercial modules. (Author's abstract)
W87-01102

MODELING OF SMALL SCALE REVERSE OSMOSIS SYSTEMS,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
C. S. Slater, J. M. Zielinski, R. G. Wendel, and C. G. Uchrin.
Desalination, Vol. 52, No. 3, p 267-284, August 1985. 7 fig, 2 tab, 13 ref.

Descriptors: *Reverse osmosis, *Model studies, *Mathematical equations, *Simulation analysis, *Mass transfer, *Closed systems, Solutes, Solvents, Sodium chloride, Industrial wastewater, Fluctuations, Osmotic pressure, Membranes.

A reverse osmosis system operating in a closed loop environment is modeled as a nonlinear differential equation that represents feed concentration as a function of time. Correlations of flux, solute concentrations and rejection with operating time and overall system recovery are functions of the model. Simple salt and complex industrial wastewater experiments were conducted to verify the model. Results indicated a good fit to the data over the range studied. Use of the model to predict system performance at long operating times or high recovery rates is questionable due to the effects of mass transfer inhibition that are not considered in the model. (Michael-PTT)
W87-01103

WETTABILITY, REWETTABILITY AND BREAKDOWN OF THIN FILMS OF AQUEOUS SALT SOLUTIONS,
Tel-Aviv Univ. (Israel). School of Engineering.
N. Brauner, D. M. Maron, and Z. Harel.
Desalination, Vol. 52, No. 3, p 295-307, August 1985. 9 fig, 17 ref.

Descriptors: *Wettability, *Thin films, *Saline water, *Evaporators, *Calcium chloride, *Tap water, *Condensers, Density, Viscosity, Surface tension, Heat transfer, Temperature effects.

Wettability, rewettability and breakdown of continuous films on heat transfer surfaces were studied for tap water and calcium chloride solutions. The effects of temperature level, physical properties and liquid properties such as density, surface tension and viscosity were analyzed. It was found that

minimum wetting rates decrease when calcium chloride concentration is increased. The effect of temperature decreases minimum wetting rates on dry surfaces while the mean wetting rate and critical rate for film rupture remain unchanged. The current study is part of a wider project to define the range of operation in related film flow contactors for development of a vertical plate evaporator-condenser unit. (Michael-PTT)
W87-01105

WATER TRANSPORT STUDIES ON INTERPOLYMER ION-EXCHANGE MEMBRANES,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
V. K. Indusekhar, and N. Krishnaswamy.
Desalination, Vol. 52, No. 3, p 309-316, August 1985. 1 fig, 3 tab, 25 ref.

Descriptors: *Desalination, *Water transport, *Ion exchange, *Membranes, *Electrodialysis, *Electroosmosis, *Electric currents, Sodium chloride, Potassium chloride, Lithium chloride.

This study investigated water transport across interpolymer ion-exchange membranes. Volume changes were observed in an electrodialysis cell and water transport at different current densities was calculated for three univalent metal salt solutions. It was observed that water transport decreased with increasing current density and approached a limit at moderate current densities. (Michael-PTT)
W87-01106

BRACKISH WATER DESALINATION BY A CONTINUOUS COUNTER-CURRENT ION-EXCHANGE TECHNIQUE,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
M. N. Prajapati, P. M. Gaur, and B. D. Dasare.
Desalination, Vol. 52, No. 3, p 317-326, August 1985. 7 fig, 2 tab, 9 ref.

Descriptors: *Desalination, *Brackish water, *Ion exchange, *Regeneration, *Fluidized beds, *Cost analysis, Resins, Anion exchange, Cation exchange, Leakage, Influent water, Investment, Acidity.

A counter-current ion exhange fluidized bed process was developed for brackish water desalination to reduce regenerent consumption and cost and resin investment. Parameters such as influent acidity, regeneration level and rinse water consumption were evaluated in the cation and anion cycles. Potential relative savings in equipment and resin investment, rinse water requirements and operating costs were estimated in relation to the conventional fixed-bed ion exchange technique. (Michael-PTT)
W87-01107

MODIFICATION OF CELLULOSE ACETATE BY PROPYLENE OXIDE,
National Chemical Lab., Poona (India). Div. of Polymer Chemistry.
S. S. Mahajan, M. B. Sabne, K. B. Gujar, and N. D. Ghatge.
Desalination, Vol. 52, No. 3, p 327-333, August 1985. 2 fig, 3 tab, 4 ref.

Descriptors: *Polymers, *Cellulose acetate membranes, Propylene oxide, Cellulose acetate, Viscosity, Strength, Reverse osmosis, Thermal stress.

Membranes prepared from propylene oxide modified cellulose acetate were found to exhibit a higher percentage of salt rejection with reduced water flux in reverse osmosis. Thermogravimetric analysis indicated that partial modification by propylene oxide had no effect on thermal stability at temperatures up to 300 C. (Author's abstract)
W87-01108

WATER DESALINATION IN SOLAR EARTH STILLS: A NUMERICAL STUDY,
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
R. Avissar, and Y. Mahrer.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1067-1075, July 1975. 9 fig, 2 tab, 24 ref.

Descriptors: *Desalination, *Solar earth stills, *Mathematical studies, Demineralization, Desalination apparatus, Stills, Model studies, Mathematical models, Temperature, Hydraulic properties, Simulation analysis, Israel, Water table, Water supply development, Drinking water.

To simulate water desalination in solar earth stills, a numerical one-dimensional model was developed, which considers four layers: cover, soil, enclosed, and external air. The soil layer is divided into thin homogeneous sublayers, whose thermal and hydraulic properties are computed, during the simulation, by taking into account their temperature and humidity. Given adequate photometric properties, any covering material can be simulated. The model was experimentally verified and applied to two different climatological regions in Israel, examining the influence of water table depth on the amount of collected fresh water in two different types of solar earth stills. The model is able to predict accurately the amount of drinking water collected in a solar earth still. This method of water desalination is applicable in regions where the water table is near the soil surface, and assuming the daily drinking water consumption per capita to be about 10 L, a solar earth still of 4,000 sq m will suffice to supply drinking water for Neot Hakikar (250 inhabitants). Although this method has not been economically researched, it does seem very promising. (Lantz-PTT)
W87-01446

3B. Water Yield Improvement

SHORT-TERM EFFECTS OF ARTIFICIAL OASES ON WILDLIFE,
Arizona Cooperative Wildlife Research Unit, Tucson.
N. S. Smith, and R. S. Henry.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86-196797, A07 in paper copy, A01 in microfiche. Final Report, July 1985. 133 p, 21 fig, 19 tab, 26 ref, 17 append. Bureau of Reclamation Agreement No. 9-07-30-X0069.

Descriptors: *Ecological effects, *Oases, *Central Arizona Project, *Wildlife conservation, Wildlife management, Artificial watercourses, Vegetation effects, Reptiles, Birds, Mammals, Amphibians, Water supply.

Artificial oases were proposed to help mitigate the effects on wildlife of the Central Arizona Project. The artificial oases were designed to supply water to native vegetation and wildlife. Six watered plots and 5 control plots were monitored for over 4 years. Densities or abundance indices and species composition of vegetation, reptiles, amphibians, birds, rodents and other mammals were monitored before and after application of water to the treated plots. Vegetation that received water was significantly affected but because the total amount was small, the overall affect on wildlife was minimal. Densities of lagomorphs, Mourning Doves, Gambel's Quail, and House Finches increased on the watered plots because they concentrated there rather than because production was increased by the water. There were no significant differences in the total number of birds per 100 counts. Heteromyid rodents were not affected and there was no evidence of increased reptilian, avian or mammalian predation. Because 1 acre-foot of water/yr delivered by low maintenance systems effected only a small total area, it is recommended that other methods be used to offset for loss of habitat due to the construction of the Central Arizona Project. One such method would be to protect the vegetation on the upslope side of the canal from livestock grazing. (Author's abstract)
W87-00891

ARIZONA WATER SUPPLY OUTLOOK AND FEDERAL-STATE-PRIVATE COOPERATIVE SNOW SURVEYS,
Soil Conservation Service, Phoenix, AZ.
R. A. Jones.
Available from the Soil Conservation Service, 210 East Indianola, Suite 200, Phoenix, Arizona. 85012. March 1, 1986. 17 p.

Descriptors: *Water supply, *Arizona, Forecasting, Seasonal variation, Reservoirs, Snowpack, Snowmelt, Precipitation, Runoff, Salt River, San Francisco River, Gila River, Surface water, Lyman Lake, Streamflow.

The general outlook still calls for variable surface water supplies in Arizona. Although reservoir storage is near to above normal for March 1, the forecasts for March-May streamflow are still well below average. This is somewhat of a paradox since fairly abundant precipitation, combined with snowmelt from a period of above average temperatures, produced near average runoff on many streams during February. Streamflow forecasts are low because very little snowpack remains. Runoff is expected to be 33% of average on the Salt River and 27% on the Verde. Inflow to Salt River Project is forecast at 167,000 acre feet. The San Francisco River is forecast to run 64% of average at Clifton. Forecast on the Gila River call for 67% of average at Virden, 62% at Head of Safford Valley, and 44% at Calva. Inflow to San Carlos reservoir should run 35,000 acre feet. The Little Colorado River is forecast to produce 34% of average flow at Lyman Lake. The forecast of the Colorado River at Lake Powell has increased to 11,000,000 acre feet at 147% as a result of February storms. (Author's abstract)
W87-00979

PROJECT SKYWATER: 1984-85 SCPP DATA INVENTORY.
Bureau of Reclamation, Denver, CO.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86 184512, A12 in paper copy, A01 in microfiche. August 1985. 240 p, 41 fig, 46 tab, 5 append.

Descriptors: *Artificial precipitation, *Project Skywater, *Data collections, *Cloud seeding, *Weather modification, Sierra Cooperative Pilot Project, Forecasting, Measuring instruments, Data acquisition, Networks, Radar, Rain gages, Precipitation, Snow, Radiosondes, Meteorological data collection, Remote sensing.

This report contains an inventory of all data collected from October 15, 1984, through April 1985 in association with the SCPP (Sierra Cooperative Pilot Project), a weather modification research project in winter orographic cloud seeding. It is subdivided into an introduction plus 12 sections and 5 appendices : (1) Forecasting, (2) Radar, (3) Satellite, (4) Aircraft, (5) Rawinsondes, (6) Surface Meteorological Observations, (7) Precipitation Gage Network, (8) Ground-based Microphysical Observations, (9) Radiometer, (10) Cooperative and Operational Seeding Activities, (11) Snow Chemistry Measurements, (12) National Weather Service, Aviation Administration, and National Climatic Center Products, and (app. A) Sierra PROBE Data Availability, (app. B) SCPP Operations for 1984-85, (app. C) University of Wyoming King Air Flight Summary Notes, (app. D) CP-4 Doppler Radar Operations Summary Notes, (app. E) Detailed Descriptions of K sub a band Radar Calibrations. Most of the sections are subdivided into three main components: (1) a general description of equipment, modes of operation, and types of data available for analysis (both visual products and computer files); (2) samples of primary visual products; and (3) tables of data inventories which list start and stop times, locations, and other pertinent information related to data sampling. (Author's abstract)
W87-00980

REVIEW OF THE SIERRA COOPERATIVE PILOT PROJECT,
Bureau of Reclamation, Auburn, CA. Auburn-Folsom South Unit.
D. W. Reynolds, and A. S. Dennis.
Bulletin of American Meteorological Society Vol.

67, No. 5, p 513-523, May 1986. 10 fig, 5 tab, 25 ref.

Descriptors: *Cloud seeding, *Sierra Cooperative Pilot Project, *American River Basin, *Remote sensing, California, Nevada, History, Aircraft, Rawinsondes, Numerical models, Orographic clouds, Glaciogenic seeding.

Historical background, design, special equipment (aircraft, rawinsondes, radar), physical observations within Sierra Nevada storms, seeding suspension criteria, seeding studies, and current status of the Sierra Cooperative Pilot Project (SCPP) are reviewed. The SCPP is an investigation of cloud seeding as a way of increasing winter precipitation on the Sierra Nevada (American River basin, California-Nevada). It is a concerted effort in the development of a physically sound cloud-seeding technology. It involves the use of remote-sensing devices, in situ observations, and the application of a numerical targeting model in randomized seed experiments. The results have led SCPP scientists to believe that shallow but widespread orographic clouds provide the best opportunity for glaciogenic seeding in the central Sierra Nevada. (Rochester-PTT)
W87-01095

DEVELOPMENT OF A HYDRAULIC SEEDING TECHNIQUE FOR UNSTABLE SAND SLOPES: II. FIELD EVALUATION,
Liverpool Univ. (England). Dept. of Botany.
R. D. Roberts, and A. D. Bradshaw.
Journal of Applied Ecology JAPEAI, Vol. 22, No. 3, p 979-994, December 1985. 9 fig, 2 tab, 25 ref.

Descriptors: *Hydraulic seeding, *Sand, *Natural slope, *Field tests, *Slope stabilization, *Soil stabilization, Waste dumps, Industrial wastes, Mulching, Fertilizers, Stabilizers, Grasses, Seeds, Seedlings, Dispersants, Clays, Compacted soils, Erosion, Nitrogen.

Hydraulic seeding techniques are examined in a series of field trials on china clay sand wastes using a clover and grass seed mixture. The techniques are evaluated with regard to the effects of mulching, substrate characteristics and weather on the availability of favorable microsites and seed burial processes. Conventional techniques produced only limited establishment of grasses and legumes because of fertilizer toxicity and germination inhibition by stabilizers. Seedling establishment was improved by adding mulch in situations where natural seed burial was limited or dry soil prevailed. Seed establishment was improved in some cases where fertilizer was omitted or its application delayed until after germination. Effective mulching and stabilization was obtained by using long fiber flexible materials rather than those used in conventional hydraulic seeding treatments. It is suggested that more attention be paid to legume requirments since many commercial hydraulic seeding operations fail because of nitrogen deficiency. (Michael-PTT)
W87-01126

3C. Use Of Water Of Impaired Quality

PUTTING WASTEWATER TO WORK,
Howard, Needles, Tammen and Bergendoff, Orlando, FL.
R. C. Murphy.
Civil Engineering, Vol. 56, No. 6, p 77-79, June 1986. 2 fig.

Descriptors: *Altamonte Springs, *Water reuse, *Irrigation, Process water, Fire protection, Water quality standards, Viral analysis, Florida.

Altamonte Springs, Florida, is instituting project APRICOT (A Prototype Realistically Innovative Community of Today), which is an 11 million dollar dual water transmission system that will deliver highly-treated wastewater for applications that do not require potable water. Non-potable water conveyed by project APRICOT will be used for irrigation of residential, public, and commercial properties; road medians; citrus groves; tree farms; crops and golf course; and parks and recreation facilities. The reclaimed water also will be used for fire protection, lake level control, fountains and waterfall, and eventually for toilet flushing, sprinkler systems, once-through cooling, process water and general outside uses, such as automobile washing. Cost of reclaimed water, future water demand in the Altamonte Springs area, standards for reclaimed water, and dealing with virus contamination are discussed. (Rochester-PTT)
W87-01047

ALUMINUM-THIOUREA INHIBITORS OF MILD STEEL CORROSION IN HIGH SPECIFIC SALINITY WATER. COMPATIBILITY WITH CALCIUM, MAGNESIUM AND FERROUS IONS AT VARIOUS TEMPERATURES,
Higher Inst. of Mechanical and Electrical Engineering, Sofia (Bulgaria).
M. Iovchev.
Desalination, Vol. 52, No. 3, p 285-293, August 1985. 5 fig, 1 tab, 13 ref.

Descriptors: *Corrosion inhibitors, *Aluminum, *Thiourea, *Cooling water, *Inhibition, *Powerplants, *Salinity, *Calcium, *Magnesium, *Iron, *Steel, Ions, Recirculated water, Cooling water, Chemical reactions, Cost analysis, Zero discharge, Pretreatment of water.

Two representative aluminum-thiourea inhibitor formulations were measured in the presence of calcium, magnesium and ferrous ions using the weight loss method. Inhibitive efficiencies of the tested formulations sharply decreased in the presence of calcium ions while the action of magnesium and ferrous ions did not appear to have a critical influence on the inhibitive properties of the formulations. Results indicate that aluminum-thiourea inhibitors can be used in zero-discharge cooling water systems if calcium ions can be completely removed from makeup and recirculating cooling water. The cost of water treatment in cases where makeup water is very hard would preclude the use of mild steel in zero-discharge cooling water systems of steam plants. (Michael-PTT)
W87-01104

USE OF HOT WATER DISCHARGED BY THE FESSENHEIM NUCLEAR POWER PLANTS FOR FOREST PRODUCTION, (UTILISATION DES EAUX CHAUDES REJETEES PAR LES CENTRALES NUCLEAIRES DE FESSENHEIM EN VUE D'UNE PRODUCTION SYLVICOLE),
Centre de Recherches de Colmar (France). Station d'Agronomie.
J. E. Delphin, and C. Schenck.
La Houille Blanche, No. 6/7, p 559-572, 1985. 16 tab, 10 ref.

Descriptors: *Nuclear powerplants, *Fessenheim, *Waste heat, *Water reuse, Cooling Water, Biomass, Water potentials, Forestry, Paper industry, France, Groundwater pollution, Thermal pollution.

In 1980, the Societe hydrotechnique de France (Hydrotechnical Society of France), in the framework of the 16th Days on Hydraulics, presented a paper (Specty and Meyer 1980) concerning production of biomass utilizing the hot water discharged from the Fessenheim nuclear powerplants. This article gives a synopsis of the results of the experiment after six years. The study concludes that the direct use of discharged water is not practical. The caloric content of the water would first have to be concentrated, perhaps by a heat pump. Even so, there remain problems: the risk of pollution of the groundwater, and the necessity of applying the water only in conjunction with a shelter to minimize loss of heat to the atmosphere. (Airone-PTT)
W87-01332

TRACE METAL SPECIATION IN A SOIL PROFILE IRRIGATED WITH WASTE WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-01581

SIMULATION OF LEACHING OF A GYPSIFEROUS-SODIC DESERT SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 2G.
W87-01636

3E. Conservation In Industry

WATER RATES: AN INDUSTRIAL USER'S VIEW,
Drazen-Brubaker and Associates, Inc., St. Louis, MO.
For primary bibliographic entry see Field 6C.
W87-01019

3F. Conservation In Agriculture

ANNUAL REPORT: 1984.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
1984. 94 p, 8 fig, 6 tab.

Descriptors: *Annual reports, *Water policy, *Agriculture, Irrigation, Economic aspects, Short-term planning, Long-term planning, Education, Research priorities, Malawi, Monitoring, Drainage practices.

In view of the changing ideas and policies to assist Third World countries in developing their economies and particularly their agriculture, the year 1984 was one of reflection on the Institute's short-term and long-term policies. This document outlines these policies with regard to the Institute's three-fold task: Education, Research, and Advice. Presented are articles discussing: (1) Monitoring programs in drainage projects: the need for them, their importance, objectives, elements, and possible results; (2) Irrigation research and development in Malawi; and, (3) Where water leaves the irrigation system. (Lantz-PTT)
W87-00886

IRRIGATED LANDS ASSESSMENT FOR WATER MANAGEMENT: TECHNIQUE TEST,
California Univ., Berkeley. Remote Sensing Research Program.
For primary bibliographic entry see Field 7B.
W87-00953

CARBOHYDRATE RESERVES AND REPRODUCTIVE DEVELOPMENT AT LOW LEAF WATER POTENTIALS IN MAIZE,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W87-01109

RELATIONS AMONG RELATIVE LEAF WATER CONTENT, GROWTH, AND RUBBER ACCUMULATION IN GUAYULE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W87-01110

EFFECT OF WATER STRESS ON CANOPY SENESCENCE AND CARBON EXCHANGE RATES IN COTTON,
Agricultural Research Service, Mississippi State, MS.
For primary bibliographic entry see Field 2I.
W87-01111

EVALUATION OF PEANUT GENOTYPES FOR RESISTANCE TO WATER STRESS IN SITU,
FMC Corp., Princeton, NJ.
P. I. Erickson, and D. L. Ketring.
Crop Science CRPSAY, Vol. 25, No. 5, p 870-876, September-October 1985. 4 fig, 4 tab, 32 ref.

Descriptors: *Plant physiology, *Water shortage, *Osmosis, *Leaves, *Water potential, *Moisture stress, *Turgor, *Peanuts, Irrigation, Rainfall, Crop yield.

Field studies were conducted to examine the differences in leaf water potential, turgor potential and relative water content and its apoplastic water fraction among Spanish, Virginia and Spanish x Virginia crossed peanut plants grown under irrigated and rainfed conditions. The relative differences in dehydration resistance and yield potential of each genotype was also studied. Results indicate that apoplastic water fraction varies in peanuts and may be genotype specific. The lower leaf water potential, greater change in osmotic potential and higher apoplastic water fraction and yield in the rainfed Spanish peanut plants suggests greater resistance to dehydration when high soil moisture deficits and evaporative demand conditions occur. (Michael-PTT)
W87-01112

DEVELOPMENT OF MICRO-CATCHMENTS IN SRI LANKA,
Resources Development Consultants Ltd., Colombo (Sri Lanka).
For primary bibliographic entry see Field 4A.
W87-01192

CROPLAND SOURCES OF WATER POLLUTION,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 5B.
W87-01202

CONFRONTING DROUGHT: THE FRENCH EXPERIENCE (FAIRE FACE A LA SECHERESSE: L'EXPERIENCE FRANCAISE),
Agence Financiere de Bassin Seine-Normandie, Paris (France).
G. Bediot.
La Houille Blanche, No. 6/7, p 545-557, 1985. 2 fig, 3 tab, 33 ref.

Descriptors: *Drought, *Agriculture, *France, Drinking water, Irrigation, Water table decline, Hydroelectric power, Low flow, Governmental interrelations, Watercourses, Piezometry.

The French experience, in particular in 1976, is analyzed. The agents involved include both the professional organizations adversely affected by the phenomenon and the government agencies responsible for setting up structures to cope with the drought in farming, the deficient stream flow (a cause of concern for Electricite de France), the piezometric decrease (which concerns both drinking water and irrigation), and the drop in low water flow, accompanied by very strong degrading of quality and which could result in total or partial drying up of the waterways. The actions taken and their results are described for each sector of activity. (Author's abstract)
W87-01331

INFLUENCE OF DIFFERENT IRRIGATION METHODS AND INTERVALS ON THE INFESTATION OF VIGNA UNGUICULATA SSP. CYLINDRICA BY UROMYCES SPP. UNDER ARID CONDITIONS, (EINFLUSS UNTERSCHIEDLICHER BEWAESSERUNGSVERFAHREN UND -INTERVALLE AUF DEN BEFALL VON VIGNA UNGUICULATA SSP. CYLINDRICA DURCH UROMYCES SPP. UNTER ARIDEN BEDINGUNGEN),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Oekologie.
For primary bibliographic entry see Field 2I.
W87-01349

COST BORNE BY ELECTRICITY CONSUMERS UNDER EXPANDED IRRIGATION FROM THE COLUMBIA RIVER,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 6C.
W87-01525

FINANCIAL AND ECONOMIC IRRIGATION NET BENEFIT FUNCTIONS FOR EGYPT'S NORTHERN DELTA,
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6C.
W87-01526

SURFACE IRRIGATION ADVANCE MOTION AFTER GATE CLOSURE,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
For primary bibliographic entry see Field 8B.
W87-01535

UPTAKE OF CADMIUM, LEAD AND NICKEL BY CORN GROWN IN CONTAMINATED SOILS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 5B.
W87-01566

ACCOUNTING FOR SPATIALLY VARIABLE INFILTRATION IN BORDER IRRIGATION MODELS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes, and A. J. Clemmens.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1257-1262, August 1986. 2 tab, 20 ref, append.

Descriptors: *Infiltration, *Spatial distribution, *Irrigation, *Model studies, Irrigation practices, Simulation analysis, Distribution patterns.

A simple combination of variances technique incorporates the spatial variability of infiltration rates into the irrigation uniformity predictions of border irrigation models. The mean and variance of the depth of infiltrated water across a border can be calculated directly from the infiltration opportunity time results of a single border irrigation simulation and the distributions of the infiltration parameters for the border. Infiltration depth results are not needed. The single irrigation simulation is run using the expected values for the infiltration parameters to describe uniform infiltration across the border. These results can be used to calculate the irrigation distribution uniformity coefficient DU, where care must be used if the depths of infiltration are assumed normally distributed. Although only normal and lognormal distributions are discussed, the techniques described can be applied to any infiltration parameter distribution. (Author's abstract)
W87-01627

CHANGES IN CUTICULAR TRANSPIRATION RATE AND CUTICULAR LIPIDS OF OAT (AVENA SATIVA) SEEDLINGS INDUCED BY WATER STRESS,
Goeteborg Univ. (Sweden). Dept. of Botany.
For primary bibliographic entry see Field 2I.
W87-01638

EFFECTS OF FAR-RED LIGHT ON MALATE AND POTASSIUM CONTENTS IN COTTON LEAVES: RELATION TO DROUGHT RESISTANCE,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Inst. de Physiologie Vegetale.
For primary bibliographic entry see Field 2I.
W87-01639

SOME PHYSIOLOGICAL AND GROWTH RESPONSES OF KIWI FRUIT (ACTINIDIA CHINENSIS) TO FLOODING,
Carretera de Cabrils s/n, Barcelona (Spain). Unitat de Tecnologia i Agroenergetica.
For primary bibliographic entry see Field 2I.
W87-01640

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

LAKESHORE REVEGETATION STUDIES AT LAKE OAHE, SOUTH DAKOTA,
South Dakota Univ., Vermillion. Dept. of Biology.
G. R. Hoffman, S. G. Shetron, C. V. Klimas, and H. H. Allen.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report E-86-3, March 1986. Final Report. 18 p, 2 fig, 3 tab, 1 append.

Descriptors: *Lake shores, *Revegetation, *Lake Oahe, South Dakota, Flood plain management, Reservoirs, Shoreline cover, Shore protection.

A 4-year study was conducted to assess the flood tolerance of plant species selected as potentially useful in revegetating shorelines of fluctuating water-level reservoirs. The study employed a subimpoundment adjacent to Lake Oahe, S. Dakota, to systematically inundate 55 transplanted species. Survival and growth of each species were monitored regularly. Eight plant species demonstrated sufficiently consistent responses to inundation to merit recommendations for planting in specific shoreline environments. Fourteen additional species showed some degree of flood tolerance and are recommended for trial plantings in particular circumstances. Of all the species tested, Phalaris arundinacea is by far the best candidate for a wide range of shoreline site conditions in the northern prairie region. The Lake Oahe study also suggested that, in planning a shoreline project, careful assessments of species characteristics, substrate type and configuration, and wind and wave action be made prior to any field effort. Further, a successful transplanting operation must include careful attention to the newly planted vegetation during the critical establishment period. (Author's abstract)
W87-00872

ARIZONA WATER SUPPLY OUTLOOK AND FEDERAL-STATE-PRIVATE COOPERATIVE SNOW SURVEYS,
Soil Conservation Service, Phoenix, AZ.
For primary bibliographic entry see Field 3B.
W87-00979

DEVELOPMENT OF A HYDRAULIC SEEDING TECHNIQUE FOR UNSTABLE SAND SLOPES: II. FIELD EVALUATION,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 3B.
W87-01126

INGESTION AND ASSIMILATION OF ALGAE BY NAIS ELINGUIS (OLIGOCHAETA: NAIDIDAE),
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. W. Bowker, M. T. Wareham, and M. A. Learner.
Oecologia (Berlin), OECOBX, Vol. 67, No. 2, p 282-285, September 1985. 1 fig, 2 tab, 12 ref.

Descriptors: *Nais, *Annelids, *Algae, *Benthic fauna, Diatoms, Nitzschia, Ecology, Aquatic animals, Benthos, Fauna, Chlorella, Scenedesmus, Chlorophyta, Ely River, Waters.

Nais elinguis collected in spring from the River Ely, Wales, was offered equal densities of three algal species under controlled conditions in the laboratory. Colonies of Scenedesmus quadricauda (Chlorophyta: Chlorococcales) were ingested at significantly lower rates than cells of (Chlorococcales). Labelled cells of Nitzschia were more rapidly and more efficiently assimilated than those of the other algae. Cells of least palatable and least

assimilable alga in this test implies some relationship between palatability and assimilability. However, Nitzschia and Chlorella were equally palatable but not equally assimilable. Nais benefits from an ability to discriminate against Scenedesmus, since the cells are virtually unassimilable. (Doria-PTT)
W87-01145

DEVELOPMENT OF HABITAT TIME SERIES,
Fish and Wildlife Service, Fort Collins, CO. Cooperative Instream Flow Service Group.
For primary bibliographic entry see Field 2H.
W87-01160

DEVELOPMENT OF MICRO-CATCHMENTS IN SRI LANKA,
Resources Development Consultants Ltd., Columbo (Sri Lanka).
U. D. Udawattage.
Journal of Hydrology JHYDA7, Vol. 80, No. 3/4, p 351-359, October 15, 1985. 3 fig, 6 ref.

Descriptors: *Microcatchments, *Sri Lanka, *World Bank, Catchment areas, Reservoirs, Collecting areas, Irrigation, Water storage.

The development of microcatchments in Sri Lanka for irrigation was considered. The detailed investigation and preparation of technical proposals for the improvement of 170 existing micro-scale reservoir schemes in the Puttalam and Kurunegala districts, over a period of three years, under a World Bank-financed project called 'integrated Rural Development (IRD) Project' is presented. Investigations were carried out by a private body called Planning Consultancy, a professional staff comprising a team of eight engineers from the Resources Development Consultants Ltd., Sri Lanka, under a contract with the ministry of Plan Implementation and under the supervision of the Irrigation Department. It was realized that microcatchments are very important to the rural life and economy in Sri Lanka. A serious study of this area is recommended. (Khumbatta-PTT)
W87-01192

METHOD TO OPTIMIZE THE FLOOD RETENTION CAPACITY FOR A MULTI-PURPOSE RESERVOIR IN TERMS OF THE ACCEPTED RISK,
Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
L. V. Tavares, and J. Kelman.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 127-135, October 30, 1985. 1 fig, 4 ref.

Descriptors: *Reservoir operation, *Flood retention, *Reservoir releases, *Multi-purpose reservoirs, *Flood control storage, Stochastic models, Flood prevention, Flood proofing, Mathematical studies, Impoundments, Stochastic path method.

When reservoirs are operated for multiple purposes, i.e., to maintain a dependable supply of water and to mitigate downstream flooding, it is necessary to develop some criteria to balance the two opposing goals. An approach to the problem is estimating the flood retention capacity at each time interval t, FC(t), in terms of the accepted risk of downstream flooding, alpha, and then using FC(t), as a contraint to the operation rules aimed to maximize the firm yield. The stochastic path method (SPM) is presented as a technique for estimating the flood retention capacity. No information is required about the reservoir operating rules and hence this method is particulary valuable for the planning stage. A computational algorithm for SPM is presented and the results obtained to applying this method are discussed. The major disadvantage is the necessity of using a sufficiently long time series of streamflows, often implying the adoption of a synthetic generator. The quality of the estimated results is largely dependent on the validity of the generator. (Khumbatta-PTT)
W87-01194

MATHEMATICAL MODELLING OF YACYRETA-APIPE SCHEME ON THE RIO PARANA,
Lahmeyer International G.m.b.H., Frankfurt-am-Main (Germany, F.R.).
T. F. Major, A. Lara, and J. A. Cunge.
La Houille Blanche, No. 6/7, p 519-527, 1985. 6 fig, 4 tab, 2 ref.

Descriptors: *Parana River, *Yacyreta-Apipe, *Mathematical models, Hydroelectric power, CARIMA, Flow, Watercourses, Compensating reserviors.

The CARIMA flow model was applied to a section of approximately 200 km of the Rio Parana in Argentina. A 1420 sq km reservoir will collect the waters of a 975,000 sq km catchment area and will store 16.9 billion cu meters. Two spillways are designed for a flood flow of 95,000 cu m/sec. A compensating dam will store 2180 M cu m with a surface area of 800 sq km. The operating discharge of the hydropower plant will be between 14,000 and 21,000 cu m/sec. The paper describes the project and the CARIMA flow model (design, construction, calibration, use). The model indicates that a compensating reservoir must be established early in order to assure safe navigational conditions. (Airone-PTT)
W87-01329

CONSUMER SURPLUS UNDER UNCERTAINTY: AN APPLICATION TO DAM-RESERVOIR PROJECTS,
California Inst. of Tech., Pasadena.
For primary bibliographic entry see Field 6B.
W87-01524

HISTORICAL STREAMFLOW SUMMARY: SASKATCHEWAN, 1984.
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W87-01767

4B. Groundwater Management

MANAGEMENT OF UPLAND WATERSHEDS: PARTICIPATION OF THE MOUNTAIN COMMUNITIES,
Food and Agriculture Organization of the United Nations, Rome (Italy).
J. -J. Bochet.
Available from the Food and Agriculture Organization of the United Nations, Rome, Italy. FAO Conservation Guide No. 8, 1983. 199 p, 184 ref, 4 append.

Descriptors: *Watershed management, *Mountains, *Public participation, Management planning, Economic impact, Social impact, Legal aspects, Water use, Water management.

The purpose of this paper is to examine the role of mountain communities in the design and implementation of watershed management programs, in short, their moral commitment to and physical and material participation in these programs. Part one analyzes the problem and its effect on various socio-economic groups. Part two looks at the administrative structures and legal regulations for intervention, socio-economic data gathering and analysis, planning and programming. Part three deals with implementation: the role of the community and methods to be used. (Authors' abstract)
W87-00876

WIND ENERGY FOR IRRIGATION--WIND-ASSISTED PUMPING FROM WELLS,
Agricultural Research Service, Bushland, TX.
R. N. Clark, A. D. Schneider, V. Nelson, E. Gilmore, and R. E. Barieau.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE82-009925, Price codes: A05 in paper copy, A01 in microfiche. Final Report, DOE/SEA--7315-20741/81/3, January 1981. 63 p, 22 fig, 8 tab, 11 ref, 1 append. DOE-SEA Agreement No. EX 76-A-29-1026.

Descriptors: *Groundwater management, *Irrigation, *Pumping, *Wind turbines, Turbines, Energy, Electric power.

A wind turbine and an electric motor were used to power a conventional vertical-turbine irrigation pump. The electric motor was designed to run continuously; the wind turbine was coupled to the pumping system through an overrunning clutch and combination gear drive and furnished power to the pump only when the wind speed exceeded 6 m/sec. The wind turbine was intended to reduce the load on the motor rather than replace it. The peak power level was greatly influenced by turbine rpm, increasing from 21 kW at 68 rpm to 52 kW at 90 rpm. Slower turbine speeds began producing power at lower wind speeds. Predicted monthly output ranged from about 3000 to 8000 kWh. Monthly outputs differed by up to 1000 kW among the three speeds tested: 67, 81, and 90 rpm. Annual outputs at the three speeds were 63,800, 65,800, and 63,300 kWh, respectively. The 90-rpm speed produced the most power in spring when wind speeds were highest; the 67-rpm speed produced the most power during the summer months. Wind energy systems appeared to be mosts suitable for irrigating winter wheat in March-May and for limited or preirrigation of summer crops. (Cassar-PTT)
W87-00949

DISCHARGE CALCULATION FROM EARLY DRAWDOWN DATA IN LARGE-DIAMETER WELLS,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
For primary bibliographic entry see Field 2F.
W87-01200

LEAKING PIPES RECHARGE GROUND WATER,
Birmingham Univ. (England). Dept. of Geological Sciences.
D. N. Lerner.
Ground Water GRWAAP, Vol. 24, No. 5, p 654-622, September-October 1986. 6 fig, 4 tab, 13 ref.

Descriptors: *Leakage, *Groundwater recharge, *Pipes, *Lima, *Peru, *Hong Kong, Groundwater potential, Groundwater level, Recharge, Piezometry, Chemical analysis, Groundwater movement.

Leakage from water mains is a major source of groundwater recharge in the two urban areas studied. In Lima, Peru, leakage provides 30% of the recharge to the aquifers which in turn supply about 40% of the city's water. In Hong Kong, leakage can be the controlling factor on groundwater heads and may influence slope stability. Leakage from sewers and storm drains has not been quantified, but may be important in some situations. The contribution of leakage to groundwater can be detected in piezometer records, from groundwater chemistry, and in water balance and groundwater modeling studies. Analysis of minimum night flow measurements, water balances, and modeling can provide estimates of recharge quantities and distribution. Maximum areal rates of recharge for both cities were about 3000 mm/yr. (Lantz-PTT)
W87-01497

TYPE CURVE ANALYSIS OF INERTIAL EFFECTS IN THE RESPONSE OF A WELL TO A SLUG TEST,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-01534

UNSTEADY GROUNDWATER DRAWDOWN IN EMBANKMENTS,
Ministry of Works and Development, Rotorua (New Zealand).
For primary bibliographic entry see Field 8D.
W87-01576

MODELING OF A LIQUID PHASE GEOTHERMAL DOUBLET SYSTEM AT REGINA, SASKATCHEWAN, CANADA,
Regina Univ. (Saskatchewan). Energy Research Unit.

K. Hutchience, J. H. Weston, A. G. Law, L. W. Vigrass, and F. W. Jones.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1469-1479, September 1986. 9 fig, 2 tab, 27 ref.

Descriptors: *Model studies, *Geothermal wells, *Well field design, *Aquifer systems, *Saskatchewan, *Regina, *Groundwater management, Well hydraulics, Computer models, Mathematical models, Pumping rates, Porosity, Hydraulic conductivity, Well function, Temperature, Pore water, Pumping.

A computer-mathematical model was designed specifically to determine, at an early stage of development, an appropriate well spacing for the sedimentary-basin geothermal project at Regina, Canada. Assumptions include an infinite horizontal confined aquifer with uniform thickness and a finely dispersed pore system. The mathematical model is based on an energy balance equation that combines Darcy's law, Fourier's law, and the change in heat content of an element within the active zone of the aquifer. The numerical model is developed by means of the integrated finite difference technique. Short computer run times are achieved through the use of symmetry, an expanding grid system, and the use of the Theis solution. The model is sensitive to such factors as interwell distance, pumping rates, porosity, and aquifer thickness, but quite insensitive to hydraulic conductivity and storativity. Sample results are given for Regina aquifers undergoing both continuous and seasonal pumping. Isotherm maps show that the temperature disturbance evolves with time from a cooled, circular area around the injection well, to a strongly noncircular pattern with a protrusion of cooled water extending toward the production well. The model is used to predict time of thermal breakthrough for Regina aquifers using different pumping rates and interwell distances. Temperature histories for continuous pumping show that after thermal breakthrough, the produced water undergoes a slight decline of temperature over a considerable time span. For the withdrawal of equal volumes of fluid, the temperature disturbance around the disposal well is spread over a slightly larger area for the seasonal pumping case compared to continuous pumping. The thermal front is broader for the seasonal case because of the longer period of elapsed time during which thermal conduction occurs. For seasonal operations, thermal breakthrough will occur after less water has been pumped and there is a more gradual decline in the temperature of the production well after thermal breakthrough. (Author's abstract)
W87-01597

EXACT SOLUTION FOR THE PROBLEM OF CROSSFLOW IN A BOUNDED TWO-AQUIFER SYSTEM WITH AN AQUITARD,
Scientific Research Inst. of Petroleum Exploration and Development, Beijing (China).
For primary bibliographic entry see Field 2F.
W87-01624

4C. Effects On Water Of Man's Non-Water Activities

RESEARCH DESIGN FOR THE INVESTIGATION OF THE MARANA COMMUNITY COMPLEX,
Arizona State Univ., Tempe. Dept. of Anthropology.
For primary bibliographic entry see Field 6A.
W87-00877

ARCHAEOLOGICAL MITIGATION WORK IN THE MAY CANYON PROJECT AREA, DOLORES PLATEAU, SOUTHWESTERN COLORADO,
Woods Canyon Archaeological Consultants, Inc., Yellow Jacket, CO.
L. Honeycutt, and J. Fetterman.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB85-247617, A06 in paper copy, A01 in microfiche. July 1985. 98 p, 38 fig, 22 tab, 28 ref, 2 append. Contract No. 4-PG-47-04400.

Descriptors: *Archaeology, *May Canyon Project, *Dolores Plateau, *Colorado, Excavation, Mitigation work, Anasazi, Archaeological sites.

The construction of new roads often results in the alteration of surface and subterranean water movement. This, in turn, impacts upon any archaeological sites which may be present below the land surface. This report presents the results of archaeological mitigation work conducted by Woods Canyon Archaeological Consultants, Inc. on behalf of the United States Bureau of Reclamation, which was done in order for the Bureau of Reclamation to comply with the National Environmental Protection Act of 1966 and the National Historic Preservation Act of 1972. Archaeological mitigation work was performed on four prehistoric sites that were to be drastically affected by the proposed rebuilding of the May Canyon Road. This road, and the four sites, are located on the Dolores Plateau, north of the town of Dolores, southwestern Colorado. The archaeological mitigation work consisted of testing and excavating those portions of the four sites which were within the proposed road right-of-way. The work revealed a Pueblo I fieldhouse composed of two semi-subterranean rooms and an outdoor work area; a surface lithic and ceramic scatter; a lithic and ceramic scatter with a slab-lined work area and small pit feature; and a lithic, ceramic, and rock scatter with a small pit feature. (Lantz-PTT)
W87-00878

REPRODUCTION BY GREAT WHITE HERONS ARDEA HERODIAS IN FLORIDA BAY AS AN INDICATOR OF HABITAT QUALITY,
National Audubon Society, Tavernier, FL. Research Dept.
For primary bibliographic entry see Field 2L.
W87-01094

ALKALIZATION OF A HIGH-ELEVATION SIERRA NEVADA STREAM,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. C. Nodvin, L. B. Weeks, E. P. E. Thomas, and L. J. Lund.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1077-1082, July 1986. 6 fig, 2 tab, 19 ref.

Descriptors: *Alkalinity, *Sierra Nevada, *Streams, *Alpine regions, Bridge construction, Ecological effects, Hydrogen ion concentration, Conductivity, Calcium, Chemical analysis, Water quality, Rock Creek.

The construction of two bridges on Rock Creek, a high elevation stream in the Sierra Nevada, resulted in the elevation of stream water pH, conductivity, alkalinity, and calcium concentrations. Relative to an upstream unaffected site, the following maximum increases were observed: pH from 6.83 to 11.22, conductivity from 9 to 341 micro S/cm, alkalinity from 70 to 2001 microequivalents/L, and calcium from 54 to 2227 microequivalents/L. Major effects were likely the result of the leaching of calcium oxide hydration products from cement in the bridge structures. Chemical effects proved to be transitory, lasting less than 1 day past the time of concrete pouring. Observed chemical changes may have had a detrimental effect on the stream biota and suggest that great care should be taken to isolate concrete structures from contact with poorly buffered surface waters during the period of cement hardening. (Author's abstract)
W87-01447

EFFECTS OF CLEARCUTTING ON RAIN-ON-SNOW RUNOFF IN WESTERN OREGON: A NEW LOOK AT OLD STUDIES,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
R. D. Harr.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1095-1100, July 1986. 5 fig, 1 tab, 13 ref.

Descriptors: *Clear-cutting, *Runoff, *Oregon, *Streamflow, Rainfall-runoff relationships, Snow, Demonstration watersheds, Logging, Erosion, Forest watersheds, Snowmelt, Channel erosion.

Results of updating and reanalyzing streamflow data from studies in two experimental watersheds in western Oregon suggest that clearcut logging has altered snow accumulation and melt enough to have increased the size of peak flows caused by snowmelt during rainfall. In a 96-ha clearcut watershed in the transient snow zone, peak flows with return periods of roughly 3-8 years were higher than predicted by prelogging data. In a similarly clearcut 10-ha watershed, size of peak flows caused by melting of relatively deep snowpacks during rainfall were also higher after logging. Higher peak flows indicate a higher rate of water delivery to soils, which, in turn, suggests increased potential for both hillslope and channel erosion. (Author's abstract)
W87-01449

THREE DECADES OF POST-IMPOUNDMENT DATA ON THE LITTORAL FAUNA OF LLYN TEGID, NORTH WALES,
Waterloo Univ. (Ontario). Dept. of Biology.
H. B. N. Hynes, and U. R. Yadav.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 1, p 39-48, July 1985. 1 tab, 9 ref.

Descriptors: *Littoral environment, *Fauna, *Llyn Tegid, *Wales, *Water level fluctuations, Environmental effects, Ecological effects, Population dynamics, Population density.

Llyn Tegid was affected by the construction in 1955 of a barrage which allowed greatly increased water level fluctuations to occur. Data on the shore fauna collected in 1951-2 and at intervals thereafter until 1978-9 are analyzed. They show that at first there were many eliminations, but, as the years progressed and the engineers reduced the rate of change of the water-level, much of the fauna returned to the littoral region. However, some taxa seem to have disappeared, and others, mostly those associated with more silty conditions, have moved up from the sub-littoral and become more important. There seems to have been little change in density of animals. (Lantz-PTT)
W87-01480

URBAN WATER BALANCE: 1. A MODEL FOR DAILY TOTALS,
British Columbia Univ., Vancouver. Dept. of Geography.
C. S. B. Grimmond, T. R. Oke, and D. G. Steyn.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1397-1403, September 1986. 3 fig, 3 tab, 31 ref, append.

Descriptors: *Hydrologic budget, *Hydrologic models, *Urban hydrology, Hydrologic cycle, Evapotranspiration, Model studies, Water use, Irrigation, Sensitivity analysis.

The water balance provides a framework through which to study the interactions between the elements of the hydrologic cycle. A model for evaluating the components of the urban water balance is based on standard climate data and easily obtained parameters to describe the site. The time scale can be varied from 1 day to at least 1 year depending on the availability of appropriate input data and the form of the evapotranspiration submodel chosen. The evapotranspiration model proposed is of the combination type with modifications to allow for application to the suburban environment. An important methodological concept throughout the model is the recognition that a suburban area can be subdivided into three discrete surface types for hydroclimate purposes (impervious, pervious unirrigated, and pervious irrigated). An outline of the model, sensitivity analyses, and information for its implementation is presented. (See also W87-01590) (Author's abstract)
W87-01589

URBAN WATER BALANCE: 2. RESULTS FROM A SUBURB OF VANCOUVER, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Geography.
C. S. B. Grimmond, and T. R. Oke.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1404-1412, September 1986. 6 fig, 5 tab, 33 ref.

Descriptors: *Urban hydrology, *Hydrologic budget, *Vancouver, *British Columbia, *Hydrologic models, Annual distribution, Irrigation, Suburban areas, Temporal distribution, Model studies.

The C. S. B. Grimmond et al. water balance model is used to calculate the daily, monthly, and annual water balance components for a suburban catchment in Vancouver, British Columbia. The budget results for one complete year are presented, and where possible compared with those from other cities. The balance is also compared with that for a rural area in the region, thereby illustrating the effects of suburban development. In interpreting the results, special consideration is directed toward elucidating the role of irrigation (mainly garden sprinkling) in the suburban water balance. The temporal pattern of external water use is related to prevailing weather conditions. In particular, it is shown to be closely related to evapotranspiration. The relationship is a complex feedback system involving human as well as biophysical controls. The model is run both with, and without, an irrigation input to gauge its impact on the water budget. Together the results provide both quantitative and qualitative support for the idea that irrigation is the source of water supporting the relatively large rates of suburban evapotranspiration reported in energy balance studies. (See also W87-01589) (Author's abstract)
W87-01590

4D. Watershed Protection

MANAGEMENT OF UPLAND WATERSHEDS: PARTICIPATION OF THE MOUNTAIN COMMUNITIES,
Food and Agriculture Organization of the United Nations, Rome (Italy).
For primary bibliographic entry see Field 4B.
W87-00876

APPROACHES TO REVEGETATE SHORELINES AT LAKE WALLULA ON THE COLUMBIA RIVER, WASHINGTON-OREGON,
Agricultural Research Service, Prosser, WA.
For primary bibliographic entry see Field 2H.
W87-00944

UPLAND WATERSHED MANAGEMENT IN RURAL PAKISTAN,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
R. K. Dixon, and J. A. Perry.
American Water Works Association Journal JAWWA5, Vol. 78, No. 7, p 72-79, July 1986. 8 ref.

Descriptors: *Pakistan, *Erosion, *Rural areas, *Reservoir siltation, Human population, Religion, Agriculture, Economics, Reforestation, Soil water, Terraces, Riparian buffer zones, Gully plugs, Check dams, Runoff, Surface flow, Channel erosion, Bank stabilization, Economic incentives.

The principal water supply development concerns in Pakistan today are related to upland watershed management practices that result in erosion of hillsides and siltation of reservoirs and in unreliable water quantity and quality. Sociocultural constraints affecting solutions to these problems include rapid population growth, religion, an agrarian economy, and lack of environmental awareness among many rural peoples. The authors suggest the following rehabilitation priorities to encourage sage water management in Pakistan: (1) reforestation of upland watersheds to retain water on the sites longer, thus increasing soil moisture and delaying runoff; (2) construction of upland terraces, preservation of riparian buffer zones, and implementation of other surface amendments to reduce runoff velocities and retard surface erosion; (3) construction of gully plugs and check dams and stabilization of stream banks and beds to reduce stream channel erosion; and (4) economic incentives to villagers that will encourage implementation of watershed conservation practices. (Rochester-PTT)
W87-01023

EROSION AND SUSPENDED SEDIMENT TRANSPORT IN AN AGRICULTURAL BASIN. METHOD OF MEASUREMENT OF THE SURFACE RUNOFF, OF ITS SUSPENDED LOAD AND OF THE TWO COMPONENTS OF THE PARTICULATE TRANSPORT IN A RIVER (EROSION ET TRANSPORT DE MATIERES EN SUSPENSION DANS UN BASSIN VERSANT EN REGION AGRICOLE. METHODE DE MESURE DU RUISSELLEMENT SUPERFICIEL, DE SA CHARGE ET DES DEUX COMPOSANTES DU TRANSPORT SOLIDE DANS UN COURS D'EAU),
Toulouse-3 Univ. (France). Lab. de Mineralogie et Cristallographie.
For primary bibliographic entry see Field 2J.
W87-01096

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

WATER ANALYSIS, VOLUME 1: INORGANIC SPECIES,
For primary bibliographic entry see Field 2K.
W87-00913

REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,
Maryland Geological Survey, Baltimore.
For primary bibliographic entry see Field 2K.
W87-00915

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,
For primary bibliographic entry see Field 2K.
W87-00917

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,
Hach Co., Loveland, CO.
R. D. Vanous, P. E. Larson, and C. C. Hach.
IN: Water Analysis, Volume 1: Inorganic Species, Part 1, 1982. Academic Press, Inc., Orlando, FL. p 163-234, 37 fig, 6 tab, 15 ref.

Descriptors: *Turbidity, *Residue , *Suspended solids, *Measuring instruments, *Water quality monitoring, Water quality standards, Potable water, Dissolved solids, Filtration, Opacity.

Any natural-water sample that the analyst comes in contact with will invariably contain residue, which is solid matter suspended or dissolved in water or wastewater. The following are operational definitions in terms of the actual method of analysis: Total residue refers to the material left in the vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature. The total residue is customarily broken down into filterable and nonfilterable residue. Nonfilterable residue is the portion of the total residue retained by the filter. In the past, this has been reefered to as suspended solids. Filterable residue is defined as the portion of the total residue that passes through the filter. This has been referred to as dissolved solids. The various residue analyses, which include turbidimetry, are often used as indicators for the overall water quality. Potable water must meet health standards, in addition to being aesthetically acceptable. Abnormally large amounts, or a change in the constancy, of a water's residue may not be aesthetically unacceptable in terms of taste, odor, or color, but more important, they are an indicator of possible pathogenicity to the consumer. On the other hand, potable water with too little residue (i.e. filterable residue) is often aesthetically unpleasant to the consumer in terms of palatability. The importance of monitoring residue was not fully realized and its applications were not widespread until late in the 19th century. Since this time filtered water low in residue has had a marked affect in reducing waterborne diseases. While today, much more sophisticated methods are used for the determination and treatment of pathogenic organisms, organics, and inorganics, residue determinations are nonetheless quite important. Aside from the high importance we still place on aesthetic quality, residue determinations are a proven indicator of change. A sudden change of residue may indicate new pollutants, biologic, organic, or inorganic, from such diversified sources as industrial, municipal, or agricultural origins. This chapter discusses residue as well as indicating amounts of residue/ suspended solids, via the measurement of turbidity. Classification of residues, theories of light scattering, and measurements of turbidity (instrumentation) are presented, as well as direct measures of residue/ suspended solids using laboratory protocols. (Lantz-PTT)
W87-00918

SUMMARY OF METHODS FOR WATER-QUALITY ANALYSIS OF SPECIFIC SPECIES,
Geological Survey, Arvada, CO. Water Resources Div.
H. E. Taylor.
IN: Water Analysis, Volume 1: Inorganic Species, Part 1, 1982. Academic Press, Inc., Orlando, FL. p 235-273, 2 fig, 7 tab, 42 ref.

Descriptors: *Water quality management, *Water quality standards, *Water analysis, Physicochemical properties, Absorption spectroscopy, Emmission spectroscopy, Electrochemistry, Chromatography.

In the past 20 years, the field of water quality has seen a renaissance in analytical methodology, primarily in the areas of instrumental analysis of trace elements, and the automation of traditional techniques. A variety of methods have been developed to solve specific analytical problems. These problems include the determination of trace elements at lower and lower concentrations (i.e., an improvement in detection limits). As more and more information becomes available regarding toxicity of trace metals and environmental monitoring problems become more acute, the water quality chemist is called upon to provide data at or below state-of-the-art levels. This demand has spawned a continued research and development effort to expand the scope of analytical instrumentation and methodology. Provided here is a summary of some of the techniques that have found application in water analysis laboratories over the past several years. These are: (1) gravimetric analysis, (2) volumetric analysis, (3) absorption spectroscopy, (4) emission spectroscopy, (5) electrochemical methods (potentiometry, amperometry, voltammetry), and (6) chromatography. (Lantz-PTT)
W87-00919

MONITORING AGRICULTURAL CHEMICALS IN ESTUARIES,
P. A. Butler.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 213-220, 14 ref.

Descriptors: *Pollutant identification, *Estuaries, *Monitoring, Toxicity, Water pollution effects, Fate of pollutants, Pesticides, Agricultural chemicals, Aquatic animals, Sampling.

Three types of monitoring programs may be applied to estuaries: historical, mandatory, and fortuitous. Historical data is valuable for detecting long-term trends if standardized methods are consistently used. However, these programs tend to be ambiguous and lack direction. Mandated programs

often originate in spills, catastrophes, or particular environmental concerns. They have supplied much important background data. Fortuitous monitoring is often the result of scientific curiosity or availability of funds and facilities. It is problem-seeking rather than problem-solving. For example, although DDT is not expected to increase in the environment, studies are documenting its decline in the environment. Fortuitous monitoring often does not detect the presence of substances not under surveillance, as in the case of Kepone not detected during the first 4 years of James River monitoring for chlorinated hydrocarbons. Current testing programs require long-term and inclusive toxicity testing before products are released by the manufacturer. Thus, field monitoring is expected to be less important. A particular problem is the existence of pesticides toxic to nontarget species at levels less than detectable by present analytical methods. (See also W87-00957) (Cassar-PTT)
W87-00967

STREAMS AND LAKES,
McMaster Univ., Hamilton (Ontario).
For primary bibliographic entry see Field 5B.
W87-00975

EVALUATION OF CULTURE MEDIA FOR RECOVERY OF STAPHYLOCOCCUS AUREUS FROM SWIMMING POOLS,
Indiana Univ. of Pennsylvania. Dept. of Biology.
R. K. Alico, and M. P. Dragonjac.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 4, p 699-702, April 1986. 3 tab, 23 ref.

Descriptors: *Swimming pools, *Staphylococcus, *Membrane filters, Halogen levels, Chlorine, Bromine, Temperature effects, Hydrogen ion concentration, Bather density, Coliforms.

The quantitive evaluation of several different selective media for the primary isolation, recovery, and enumeration of S. aureus from the stressed environment of halogenated pool water was studied. The measurement of physical and chemical characteristics of pool water, such as halogen levels (chlorine or bromine), temperature, and pH, were included to evaluate the conditions causing stress to these organisms. The effects of various bather densities on S. aureus recovery as well as total numbers of staphylococci in pool water were also evaluated. All studies were done with membrane filters. The most selective, accurate, and reliable medium was Vogel-Johnson (VJ) medium supplemented with 0.5% pyruvate. This medium recovered two times more typical colonies than VJ medium alone, and subsequent identification of these well-defined black colonies proved that approximately 80% were S. aureus. The S. aureus recoveries correlated well with halogen levels and bather density use also. In contrast, VJ medium alone was 60% selective for S. aureus, and VJ medium supplemented with catalase did not increase either the percent recovery or the selectivity over that of VJ medium alone. Standard plate counts did not correlate with halogen levels, bather density, or total viable colonies. Coliforms were rarely recovered from indoor pool waters and were not considered to be useful indicators of water quality. (Peters-PTT)
W87-00983

COMPARATIVE STUDY OF SELECTIVE MEDIA FOR ENUMERATION OF PSEUDOMONAS AERUGINOSA FROM WATER BY MEMBRANE FILTRATION,
Malaga Univ. (Spain). Dept. of Microbiology.
A. de Vicente, J. J. Borrego, F. Arrabal, and P. Romero.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 4, p 832-840, April 1986. 4 fig, 6 tab, 25 ref. Ministerio de Educacion y Ciencia del Gobierno de Espana Grant 1158/81.

Descriptors: *Fecal bacteria, *Pseudomonas, *Bacterial analysis, *Rivers, Agars, Sewage, Membrane filtration, Water analysis.

mPA-D and mPA-E agar, modifications of mPA-C agar that reduce background fecal streptococci that interfere with the differentiation and enumeration of the Pseudomonas aeruginosa colonies grown in other mPA media, were used in analyzing natural water samples. Ten samples of polluted river water, 6 samples of seawater, and 9 samples of sewage water, all collected during an 8-week period, were used. In addition, the efficiencies of several culture media for the recovery of P. aeruginosa in water after membrane filtration and multiple-tube techniques were compared. The degree of selectivity, precision, efficiency, and sensitivity achieved with the modified media exceeded that achieved with current methods. They yielded equal rates of accuracy and specificity. Incubation at 36 C resulted in an improved recovery of stressed P. aeruginosa. It is suggested that mPA-D and mPA-E agar, incubated at 36 C for 24-48 hrs, be used for analyzing river water and seawater, respectively, for P. aeruginosa. (Author's abstract)
W87-00986

ENUMERATION AND IDENTIFICATION OF HETEROTROPHIC BACTERIA IN GROUNDWATER AND IN A MOUNTAIN STREAM,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
J. M. Buchanan-Mappin, and P. M. Wallis.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 2, p 93-98, February 1986. 3 tab, 23 ref.

Descriptors: *Groundwater, *Bacillus, *Bacterial analysis, *Fluorescence, *Pseudomonas, *Alberta, *Nalidixic acid method, *Honeycut Creek, Stream biota, Canada, Iodonitrotetrazolium formazan method, Slide culture method, Slime.

Populations of heterotrophic bacteria were enumerated from stream (Honeycut Creek) and groundwater samples taken from an undisturbed catchment basin in southwestern Alberta. Direct counts using epifluorescence microscopy, the iondonitrotetrazolium formazan method, the nalidixic acid method, and the slide culture method were made. The nalidixic acid method gave the highest results, with total viable counts as high as 34.6% of the total direct count. Attempts to enumerate bacteria on media made from decaying leaves and algal-bacterial slime gave lower values, approximately 10% of the numbers obtained on enriched media. Stream waters were dominated by Pseudomonas spp. and groundwaters were dominated by Bacillus spp. When stream diacharges and the groundwater table were low, groundwater was also dominated by Pseudomonas species. No differences were found in either numbers or species identified between tryptone-glucose-yeast extract agar, brain-heart infusion agar, nutrient agar, or casein-peptone-starch agar. It is concluded that the nalidixic acid method is the best suited for the enumeration of the bacteria in the surface waters of Honeycut Creek. A suitable method for determining viability in groundwater was not found. (Peters-PTT)
W87-00989

NOTE ON A SELECTIVE AGAR MEDIUM FOR THE ENUMERATION OF FLAVOBACTERIUM SPECIES IN WATER,
Warwick Univ., Coventry (England). Dept. of Environmental Sciences.
K. P. Flint.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 4, p 361-366, October 1985. 3 tab, 24 ref.

Descriptors: *Flavobacterium, *Bacterial analysis, *Antibiotics, *Sowe River, Microbiological studies, Microorganisms, Kanamycin, Agars, England.

Kanamycin was added to a selective nutrient agar medium to demonstrate its effectiveness in the isolation and enumeration of yellow-pigmented colonies from the River Sowe in England. The organisms were determined to be members of the genus Flavobacterium. Yellow pigmented colonies constituted less than 10% of the colonies on nutrient agar but up to 70% on nutrient agar plus kanamycin. This medium is a useful addition to those available for isolation and further study of this group of microorganisms. (Author's abstract)
W87-01005

NOTE ON THE ENUMERATION OF MANGANESE-OXIDIZING BACTERIA IN ESTUARINE WATER AND SEDIMENT SAMPLES,
Liverpool Univ. (England). Dept. of Microbiology.
P. W. L. Vojak, C. Edwards, and M. V. Jones.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 4, p 375-379, October 1985. 1 fig, 2 tab, 17 ref.

Descriptors: *Aerobic bacteria, *Manganese, *Bacterial analysis, *Biological oxidation, *Estuaries, *Sediments, *English Channel, *Tamar River, Bacteria, Peptides, Yeasts, Salinity, Manganese sulfate, Culture media.

Media for the enumeration of manganese-oxidizing bacteria in estuarine water and sediment samples from the River Tamar (SW England) were compared. A medium of peptone and yeast extract containing manganese sulfate and sea salts solution yielded the highest percentage of manganese oxidizers and high total viable counts. A survey of River Tamar and English Channel sites indicated that manganese-oxidizing bacteria comprised a significant but variable proportion (11-85%) of the total bacterial count. (Author's abstract)
W87-01006

ESTIMATED NUMBERS OF BACTERIA IN SAMPLES FROM NON-HOMOGENEOUS BODIES OF WATER: HOW SHOULD MPN AND MEMBRANE FILTRATION RESULTS BE REPORTED,
Central Public Health Lab., London (England). Communicable Disease Surveillance Centre.
H. E Tillett, and R. Coleman.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 4, p 381-388, October 1985. 2 tab 8 ref.

Descriptors: *Bacteria, *Water sampling, *Most probable number test, *Filtration, *Bacterial analysis, Biological sampling, Estimating, Mathematical equations, Probabilistic process.

A range of most probable numbers (MPN) of bacteria for certain combinations of positive tube reactions from a commonly used series is given and methods for reporting MPN results are evaluated. It is suggested that the first range of probable values, where likelihood is at least 95% for the MPN itself, should be reported as the probable result instead of a single value MPN. A second range of values is suggested to replace the 95% confidence intervals published for MPNs calculated assuming that bacteria are homogeneously distributed in large volumes of water. The MPNs calculated in the present study using exact mathematical methods and making no assumptions regarding bacteria distribution are close to published values for the particular inoculation series, but other combinations can be explored in the same way. (Michael-PTT)
W87-01007

NOTE ON THE ATTACHMENT RATE OF SUSPENDED BACTERIA TO SUBMERGED AQUATIC PLANTS IN A CALCAREOUS STREAM,
Hull Univ. (England). Dept. of Plant Biology.
C. A. Rimes, and R. Goulder.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 4, p 389-392, October 1985. 3 fig, 14 ref.

Descriptors: *Epiphytic bacteria, *Calcareous streams, *Aquatic plants, *Suspensions, *Bacterial analysis, Submerged plants, Field tests.

A method for assessing attachment rates of suspended bacteria to laboratory-grown Apium nodiflorum was developed to detect small changes in bacteria population size. It was determined that the rate of attachment to plant leaflets immersed in a stream at different concentrations of suspended bacteria was linearly related to the level of concentration. The attachment rate, relative to concentration, was 17,000 bacteria/sq cm/hr for each 100,000 bacteria/ml in the surrounding water. (Michael-PTT)
W87-01008

MERCURY CONTAMINATION IN GUADALQUIVIR RIVER MARSHES, SPAIN, USING SAMARUGO, VALENCIA HISPANICA, AS BIOLOGICAL INDICATOR,
Cordoba Univ. (Spain). Dept. de Higiene.
F. Rincon, G. Zurera, and R. Pozo-Lora.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 253-257, August 1986. 2 fig, 2 tab, 12 ref. CSIC (Spain) Contract 33021.

Descriptors: *Mercury, *Guadalquivir River Marshes, *Samarugo, *Bioindicators, Fish, Regression coefficients, Statistics, Spain, Growth.

The possible relation between mercury concentration and growth parameters was determined in field-netted samarugo fish (Valencia hispanica Val 1846) caught in the Guadalquivir River Marshes (Spain). Female fish in the sample of 85 individuals collected were significantly larger than males, but the average concentration of mercury in tissue did not differ between the sexes. The relationships weight/mercury content and length/mercury content in all fish had regression coefficients of 0.07 and 0.00, respectively, neither of which was statistically significant. (Rochester-PTT)
W87-01031

C-390 AS SOLE SELECTIVE AGENT FOR ISOLATION OF PSEUDOMONAS AERUGINOSA FROM HOSPITAL WASTE WATER,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5D.
W87-01039

NITRITE IN RAINWATER,
Essex Univ., Colchester (England). Dept. of Chemistry.
M. Radojevic.
Atmospheric Environment ATENBP, Vol. 20, No. 6, p 1309-1310, June 1986. 1 tab, 17 ref.

Descriptors: *Nitrites, *Urban areas, *United Kingdom, *Chemical analysis, *Acid rain, Japan, Bangladesh, United States, Atmospheric chemistry, Sulfur dioxide, Nitrates.

Measurements of nitrite in urban rainwater collected in the United Kingdom (34 samples: range 0.012-0.181 microgram/ml, mean 0.046) agree with earlier measurements obtained in Japan, Bangladesh, and the USA. The results show that nitrite is a minor species in rainwater, representing less than 1% of nitrate. It is concluded that the contribution of nitrite to the aqueous oxidation of SO2 and to rainwater acidity is negligible. (Author's abstract)
W87-01070

DETERMINATION OF FLUORIDE IN ENVIRONMENTALLY RELEVANT MATRICES,
Conseil Europeen des Federation de l'Industrie Chimique, Brussels (Belgium).
Unclassified report

Descriptors: *Chemical analysis, *Fluorides, Rain, Water sampling, Vegetation, Human urine, Factory air, *Water analysis, *Pollutant identification, Fluoride ion-selective electrode, Chromatography, Alkaline absorption, Stack gases, Filtration, Comite Technique Europeen du Fluor.

Analytical mehtods are described for the determination of total fluoride in gaseous emissions, rain water and aqueous effluents, vegetation, human urine, factory air, and environmental air. All the methods are based on the final measurement of fluoride by the fluoride ion-selective electrode. Interferences that cannot be eliminated by the masking power of the total ionic-strength adjustment buffer (TISAB) solution are avoided by separation of fluoride by steam distillation. Decomposition methods are used for vegetation and for samples that may contain insolubles such as stack gases or aqueous effluents. Sampling of fluoride from air is done by alkaline absorption for the high concentration range (stack gases) and by filter methods for low fluoride concentrations, eg, in factory and environmental air. Detection limits as low as 0.3 microgram/cu m fluoride can thus be achieved. The methods were established after the individual analytical procedures, common in the various member countries of Comite Technique Europeen du Fluor had been compared. The most practicable method was selected or an optimized version was designed for full testing. The accuracy of the different methods was verified by comparative tests. (Author's abstract)
W87-01073

INTERLABORATORY COMPARISONS OF THE DETERMINATION OF PH IN POORLY BUFFERED FRESH WATERS,
Freshwater Biological Association, Ambleside (England).
W. Davison, and M. J. Gardner.
Analytica Chimica Acta ACACAM, Vol. 182, p 17-31, April 30, 1986. 9 tab, 13 ref, append.

Descriptors: *Water analysis, *Acids, *Laboratory methods, *Hydrogen ion concentration, *Chemical analysis, Statistics, pH-meters, Electrodes, Dilute acids.

Ten participants gathered at one location to compare measurements, made in the field and laboratory, of the pH of quiescent solutions of natural waters and dilute acids. The total error associated with a single routine measurement in the laboratory can be controlled to within + or - 0.2 pH, comprising a standard deviations of 0.05 pH and a bias of 0.1 pH. Inaccurate preparation of standard solutions is an appreciable source of bias. Larger errors observed for field measurements made with commercial equipment arise from poorly defined analytical procedures, the use of inappropriate electrodes, and probably dampness affecting the electronics. Stirring dilute solutions depresses the pH. This bias error, which is similar for all dilute solutions, depends on the type of liquid junction used in the reference electrode. Combination electrodes produce the largest stirring shifts (>0.2 pH) and separate electrodes, especially those with free-flowing junctions, the smallest. (Author's abstract)
W87-01074

OCCURRENCE OF MONOALKYLLEAD SPECIES DURING THE SPECIATION OF ORGANOLEAD,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-01075

CARBON AND NITROGEN CONTENT OF NATURAL PLANKTONIC BACTERIA,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
T. Nagata.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 1, p 28-32, July 1986. 1 fig, 5 tab, 28 ref. Ministry of Education, Science and Culture (Japan) Scientific Research Grant 59480005.

Descriptors: *Carbon, *Nitrogen, *Bacteria, *Plankton, Lake Biwa, Japan, Mesotrophy, Fluorescence microscopy, CHN analyzer, Biomass, Glass fiber filters.

A method of estimating C and N content per unit of natural bacterial cell volume was developed. The method is based on the difference in retentiveness of bacteria between two kinds of glass fiber filter, GF/C and GF/F (Whatman, Clifton, New Jersey). Biovolume and biomass (C and N content) of bacteria that passed through the GF/C, but not the GF/F, filter were estimated with epifluorescence microscopy and a CHN analyzer, respectively. From seasonal determinations of natural planktonic bacteria in epilimnetic waters of a mesotrophic lake (Lake Biwa, Japan), the conversion factors of 106 fg of C/cu micron and 25 fg of N/cu micron were derived as average values. By using these values, the contribution of bacteria to the biomass of lake plankton is discussed. (Author's abstract)
W87-01077

NEMATODES, INCLUDING A NEW RECORD OF TOBRILUS DIVERSIPAPILLATUS IN AUSTRALIA, AS POTENTIAL INDICATORS OF SEWAGE EFFLUENT POLLUTION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2H.
W87-01084

RAPID BIOLOGICAL ASSAY AND LIMITATIONS IN MACROPHYTE ECOTOXICOLOGY: A REVIEW,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
K. H. Bowmer.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 297-308, 1986. 3 fig, 1 tab, 69 ref.

Descriptors: *Water pollution effects, *Toxicity, *Monitoring, *Rapid biological assay, *Bioassay, *Macrophytes, *Bacteria, Bacterial luminescence method, Culture methods, Photosynthesis.

The suitability of rapid biological assay for assessing toxin (particularly herbicide) effects on aquatic macrophytes is discussed. Ecofarming and aquatic weed control, time of exposure, availance, aquatic macrophytes and photosynthesis inhibitors (simulation effects, threshold levels, and resilience), and limitations of rapid biological assay are included. For photosynthesis inhibitors, information is required on the importance of the separate components of concentration and time, and for the threshold concentration below which the long-term exposure of macrophytes to photosynthetic inhibitors would have no effect. The bacterial luminescence method (without the algal culture component) is inherently insensitive to photosynthetic inhibitors. More information is required on the response of macrophytes to inhibitors before recommendations can be made on employment of aquatic macrophytes in toxicity testing. (Rochester-PTT)
W87-01088

COMPARISON OF METHODS FOR THE PREPARATION OF SEWAGE SLUDGE SAMPLES PRIOR TO SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHORUS,
Rutgers - The State Univ., Camden, NJ.
S. A. Katz, S. W. Jennis, M. Ciuffo, and R. Alberts.
Analytical Letters ANALBP, Vol. 19, No. 7/8, p 797-805, 1986. 1 tab, 4 ref.

Descriptors: *Sludge, *Phosphorus, *Molybdenum-blue method, *Laboratory procedures, Chemical analysis.

Three procedures for the preparation of sewage sludge samples prior to the colorimetric determination of P as 'molybdenum blue' were evaluated. using samples of the US Environmental Protection Agency's municipal digested sludge as reference material, sulfuric acid/ammonium persulfate digestion, muffle furnace ignition followed by extraction of the ash with hydrochloric acid, and direct extraction of the sewage sludge with sodium bicarbonate. Solutions were compared in terms of P recovery as determined by colorimetric measurements. On the basis of P recovery, the samples prepared by muffle furnace ignition/HCl extraction of the ash showed best accuracy and precision. This procedure also was superior in terms of time and effort expended in sample preparation. (Author's abstract)
W87-01092

PERIPHYTON AND MUSSELS IN MONITORING CHLOROHYDROCARBONS AND CHLOROPHENOLS IN WATERCOURSES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
P. Heinonen, J. Paasivirta, and S. Herve.
Toxicology and Environmental Chemistry TXECBP, Vol. 11, No. 3, p 191-201, 1986. 4 fig, 3 tab, 12 ref.

Descriptors: *Mussels, *Periphyton, *Chlorohydrocarbons, *Chlorophenols, *Polychlorinated biphenyls, *Pulp wastes, *Urban pollution, *Monitoring, Finland, Artificial substrates.

Incubations of plates for periphyton-growth and traps containing live lake mussels (Anodonta piscinalis) followed by analysis were tested as possible monitoring methods for chloro-organic micropollutants in watercourses in Finland affected by pulp mill effluents and urban pollution. The periphyton plate method gave results that reflect the state of pollution, but application of the method was too laborious to be practical for monitoring. In contrast, the mussel incubation and analysis procedure was more convenient to apply. The results from mussels and periphyton incubated at the same areas and time were in fair agreement. Local pollution by polychlorinated biphenyls and chlorophenols was detected readily by both methods. (Author's abstract)
W87-01099

MOLECULAR EPIDEMIOLOGY OF NON-O1 VIBRIO CHOLERAE AND VIBRIO MIMICUS IN THE U.S. GULF COAST REGION,
Maryland Univ. at Baltimore. School of Medicine.
J. B. Kaper, J. P. Nataro, N. C. Roberts, R. J. Siebeling, and H. B. Bradford.
Journal of Clinical Microbiology JCMIDW, Vol. 23, No. 3, p 652-654, March 1986. 2 fig, 1 tab, 16 ref. National Inst. of Allergy and Infectious Diseases Public Health Research Grant R22 AI19716.

Descriptors: *Epidemiology, *Microorganisms, *Genetic studies, Microbiological studies, Chromosomes, Wastewater analysis, Waste characterisitics.

The genetic relationship of ten toxigenic Vibrio cholerae non-O1 and Vibrio mimicus strains isolated from clinical and environmental sources was studied. Restriction digest patterns of chromosomal DNA and Southern blot analysis using a cholera toxin gene probe showed that the strains exhibited greater genetic differences than highly conserved V. cholera O1 strains taken from clinical and sewage samples in the Gulf Coast area. (Author's abstract)
W87-01127

USING ISOTOPE DILUTION MASS SPECTROMETRY TO DETERMINE AQUEOUS TRICHLOROACETIC ACID,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. J. Norwood, R. F. Christman, J. D. Johnson, and J. R. Hass.
American Water Works Association Journal JAWWA5, Vol. 78, No. 4, p 175-180, April 1986. 6 fig, 5 tab, 20 ref.

Descriptors: *Isotope dilution, *Mass spectrometry, *Gas chromatography, *Water analysis, *Trichloroacetic acid, *Aqueous chloroform, *Monitoring, Drinking water, Total organic halide, Residual chlorine, Water sampling, Chlorination, Raw water.

An isotope dilution gas chromatography-mass spectrometry (GC-MS) method for determining aqueous trichloroacetic acid at the micrograms-per-liter level is described. A procedure for simultaneous determination of aqueous chloroform using the same extraction and cleanup procedure is also demonstrated. The use of stable isotopically labeled internal standards for specific analytes contained in a matrix can significantly reduce systematic error from several sources. Other halogenated compounds can be determined without significant modification to the sample workup procedure. Establishment of maximum contaminant levels for a large number of chlorination by-products with different chemical and physical properties could make isotope dilution GC-MS an effective monitoring technique. (Michael-PTT)
W87-01133

SURFACE ANALYSIS OF SUSPENDED PARTICLES IN ESTUARINE AND COASTAL WATERS USING X-RAY PHOTOELECTRON SPECTROSCOPY,
Tokyo Univ. (Japan). Dept. of Chemistry.
T. Akagi, K. Fuwa, and H. Haraguchi.
Chemistry Letters CMLTAG, No. 12, p 1929-1932, December 1985. 2 fig, 2 tab, 13 ref.

Descriptors: *Suspended solids, *Estuaries, *Water sampling, *X-ray spectroscopy, Rivers, Bays, Organic compounds, Humic acid, Seawater.

Surface compositions of suspended particles in estuaries and coastal waters of the Tamagawa River-Tokyo Bay area were examined using X-ray photoelectron spectroscopy. Surface compositions changed markedly depending on sampling point locations. Results showed that mineral-rich suspended particles carried by the river were covered with organic materials such as humic acid during their flow to the bay. (Michael-PTT)
W87-01137

CONFIRMATION OF THE PRESENCE OF THE FLAME RETARDANT DECABROMOBIPHENYL ETHER IN RIVER SEDIMENT FROM OSAKA, JAPAN,
Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 839-842, June 1986. 2 fig, 6 ref.

Descriptors: *Pollutant identification, *Decabromobiphenyl ether, *Osaka, Japan, *Rivers, *Sediments, *Water pollution, chemical analysis, Water analysis, Organic compounds, Gas chromatography, Chromatography, DDT, Polychlorinated biphenyls.

Decabromobiphenyl ether (DBBE), a halogenated flame retardant similar in structure to PCBs, was detected in river sediment at Osaka, Japan. The DBBE residue level of the sample, identified by gas chromatography, was about 0.2 micrograms per gram (ppm) dry weight. The residue levels of other halogenated pollutants in the sample were as follows: PCBs, 1.5 ppm; PCTs, 0.25 ppm; HBB, 0.17 ppm; hexachlorobenzene (HCB), 0.004 ppm; DDT compounds, 0.030 ppm. The HBBE level was much higher than those of HCB and DDT compounds and about the same as those of PCTs, but only one tenth those of PCBs. River sediment pollution by DBBE may thus constitute a serious environmental problem in Osaka. (Doria-PTT)
W87-01215

MAGNITUDE AND DISTRIBUTION PATTERN OF ZINC IN OYSTERS,
South Carolina State Coll., Orangeburg.
For primary bibliographic entry see Field 5C.
W87-01218

SEPARATION AND PRECONCENTRATION OF HEAVY METALS IN ENVIRONMENTAL SAMPLES BY NICOTINIUM MOLYBDOPHOSPHATE RESIN,
Makerere Univ., Kampala (Uganda). Dept. of Chemistry.
J. T. Nyangababo, and J. W. Hamya.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 924-928, June 1986. 3 tab, 6 ref.

Descriptors: *Sample preparation, *Separation techniques, *Heavy metals, *Resins, *Nicotinium molybdophosphate resin, Water analysis, Chemical analysis.

Heteropoly molybdophosphates are capable of scavenging heavy metals selectively from high concentrations of alkali and alkaline earth elements. Results of metal recovery studies show that cobalt, chromium, copper, nickel, iron, zinc, and lead formed the strongest complexes with the nicotinium molybdophosphate resin, and were removed from solution with greatest efficiency. No sample pretreatment was necessary to achieve quantitative recovery of these elements. Distribution coefficients were obtained for the various cations; the copper ion is completely absorbed, and the compound also exhibits high affinity for Cd (II), Cr (III), Ni (II), Fe (III), Zn (II), Pb (II), and Mn (II). Heavy metal scavenging by this compound offers a new analytical tool for monitoring levels of these metals in air, water, and soil. Recovery is practically independent of the initial concentration of the heavy metal ion, and it is possible to analyze these metals in a complex mixture. (Doria-PTT)
W87-01223

BERYLLIUM IN SEDIMENTS OF NAGOYA HARBOR ESTUARIES,
Nagoya City Environmental Pollution Research Inst. (Japan).
K. Itoh.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 935-941, June 1986. 5 fig, 1 tab, 11 ref.

Descriptors: *Beryllium, *Sediments, *Estuaries, *Nagoya Harbor, Japan, *Pollutant identification, Chemical analysis, Atomic absorption spectroscopy, Spectroscopy, Sample preparation, Mineral industry, Industrial plants.

A simple and sensitive method is presented for the determination of beryllium in sediments by atomic absorption spectroscopy using methylisobutylketone extraction with acetylacetone. The method was applied to the determination of beryllium in the estuarine sediments in Nagoya Harbor, Japan. Five points were sampled, of which No. 1 was located downstream of a beryllium smelting plant which stopped its operations in 1975. The amount of beryllium here was largest, while quantities at other locations were close to the background value of beryllium in marine clay (2.6 micrograms per gram). The concentration of beryllium at No. 1 was 16 micrograms per gram at the surface layer, increasing to 35 micrograms per gram at a depth of 8 cm. Concentrations decrease with depth below that point. Results suggest that the beryllium pollution of Nagoya harbor estuaries can be attributed to the beryllium smelting point. Also, the beryllium has apparently accumulated in the sediments in the mouth of the river without spreading. (Doria-PTT)
W87-01225

NOVEL TRANSMISSIBLE FACTORS IN A NON-OL VIBRIO CHOLERAE AND A VIBRIO SP.,
Maryland Univ., College Park. Dept. of Microbiology.
A. C. Smigocki, and M. J. Voll.
Journal of General Microbiology JGMIAN, Vol. 132, No. 4, p 1027-1033, April 1986. 2 fig, 2 tab, 34 ref. Public Health Service Grant R22-A1-14242.

Descriptors: *Pollutant identification, *Vibrio, *Bacterial analysis, Pathogens, Water pollution sources.

Transmissible factors encoding production of lacunae (L factors) were demonstrated in a non-O1 Vibrio cholerae and a Vibrio sp. of recent environmental origin. Lacunae were produced in lawns of non-O1 V. cholerae indicator strains under the same assay conditions as those where lacunae were produced by the well characterized P fertility plasmid of V. cholerae O1 and the V fertility factor found in a non-cholera vibrio strain. The origin of the lacunae produced by strains harboring the V and L factors was examined. No vibriocin or phage activity was found in culture supernates or in lacunae produced by the strains, suggesting that, as in the case of the P plasmid, the lacunae probably represent sites of active mating. Unlike the P plasmid, neither the Vn or L factor could be detected or isolated by conventional plasmid techniques. (Author's abstract)
W87-01240

BACTERIOPHAGES AND INDICATOR BACTERIA IN HUMAN AND ANIMAL FAECES,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.

For primary bibliographic entry see Field 5B.
W87-01252

EVALUATION OF FILAMENTOUS ALGAE AS BIOMONITORS OF METAL ACCUMULATION IN SOFTWATER LAKES: A MULTIVARIATE APPROACH,

Toronto Univ. (Ontario). Inst. for Environmental Studies.
R. C. Baily, and P. M. Stokes.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 5-26. 6 fig, 11 tab, 24 ref.

Descriptors: *Algae, *Heavy metals, *Acid rain, *Bioaccumulation, *Bioindicators, Lakes, Acidic water, Fate of pollutants, Metals, Multivariate analysis, Path of pollutants, Lake sediments, Conductivity, Hydrogen ion concentration, Alkalinity, Canada.

Algae from artificial substrates were collected from 36 softwater lakes in four geographic areas of central Canada to evaluate algae as biomonitors of metals and to determine the levels of metals in water and sediments as they relate to other environmental variables. Determinations of aluminum, manganese, cadmium, copper, nickel, lead, and zinc were made on algae, water, and sediment. Sediment nutrients, water pH, alkalinity, and conductivity were also measured. Data were analyzed by a multivariate approach. Results showed that as pH decreased, metal concentration in water and algae increased. Sediment metals were unrelated to water pH, but were positively related to sediment organic level and algal metals. Sediment metals were approximately 1000 times the metal concentration in water, whereas algal metals were 1000 to 10,000 times greater than water levels. Filamentous algae grown on artificial substrates seem to show promise as biological monitors of metals. Their role in metal cycling in aquatic systems and as biomonitors of acid-stressed lakes is discussed. (Geiger-PTT)
W87-01290

CYANOPHAGE ASSAY AS A NEW CONCEPT IN THE STUDY OF ENVIRONMENTAL TOXICITY,

Algal Research Center, Landenberg, PA.
M. P. Kraus.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 27-41. 6 fig, 8 tab, 14 ref.

Descriptors: *Bioassay, *Toxicity, *Viruses, *Water quality, *Water pollution effects, Pollutant identification, Models, Bacteriophage, Algae, Pesticides, Assay, Hazardous materials.

For over 15 years, a virus-based assay using a cyanophage/host system has been a reliable indicator of water quality in fresh and saline water, in sewage and water treatment, and in various lagooned agricultural and industrial wastes. More recently, this host/virus model has been used in the study of toxic effects and their mechanisms of action. To better comprehend specific effects at low doses, toxicants are observed during the infectious cycle. The success of this approach depends on the genetic distinction by which one host differs from another in its sensitivity to certain cyanophages. Five cyanophages and eight hosts constitute the currently used system. A host/virus system carries the analysis into the realm of molecular biology whose vast store of genetic information on similar systems can contribute to the biological characterization of the blue-green algal system. Data acquired on formaldehyde, the s-triazine Actane, and the organophosphate pesticides Baytex and diazinon, indicate that the interaction of low doses of toxicant during the infectious cycle need not be a simple function of dose and imply that an LD50 (= median lethal dose) value, or the extrapolation of a laboratory-derived survival curve toward zero, may not be an accurate picture of environmental aquatic toxicity. In view of the current demand for in vitro screening methods, the economy and relative simplicity of the cyanophage approach is of considerable significance. (Author's abstract)
W87-01291

DIETS FOR CERIODAPHNIA RETICULATA LIFE-CYCLE TESTS,

Environmental Research Lab.-Duluth, MN.
T. J. Norberg, and D. I. Mount.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 42-52. 7 fig, 1 tab, 15 ref.

Descriptors: *Crustaceans, *Daphnia, *Fish food, *Fish diets, *Bioassay, Toxicity, Shrimp, Yeasts, Water quality.

Two diets were compared for the cladoceran, Ceriodaphnia reticulata which is commonly used as the preferred food for fish larvae and has recently been recommended as a test species for acute and chronic toxicity testing. One diet was a suspension of dry yeast dissolved in distilled water and fed at a rate of 250 micrograms per animal. The other diet was prepared from frozen adult brine shrimp (Artemia salina) and distilled water, the aged supernatant of which was fed using 0.05 mL per animal. Animals were fed daily and water changed three times each week. The feeding study was conducted for ten generations using young per female and adult survival as endpoints. The young production per female of surviving adults was comparable, but the longevity of the animals fed the yeast diet was considerably greater than that of the animals fed the shrimp diet. (Author's abstract)
W87-01292

EFFECT OF DIET ON THE SENSITIVITY OF DAPHNIA MAGNA TO LINEAR ALKYLBENZENE SULFONATE,

Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.

For primary bibliographic entry see Field 5C.
W87-01293

STUDY OF THE RELIABILITY OF DAPHNIA ACUTE TOXICITY TESTS,

Environmental Protection Agency, Cincinnati, OH. Aquatic Biology Section.
P. A. Lewis, and C. I. Weber.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 73-86. 1 fig, 4 tab, 29 ref.

Descriptors: *Daphnia, *Toxicity, *Bioindicators, *Bioassay, *Organic compounds, *Hydrogen ion concentration, Water pollution effects, Diets, Cadmium, Sulfates, Feeding rates, Hazardous materials, Testing procedures, Ecological effects.

Acute toxicity tests using Daphnia magna or D. pulex have been employed for many years to determine the toxicity of effluents and toxic substances. However, the many factors that may affect the results of such tests have received little attention. Sequential, repetitive tests were conducted with the reference toxicants sodium dodecyl sulfate (SDS), sodium pentachlorophenate (PCP), and cadmium (Cd) to determine the single laboratory precision of acute 48-yr toxicity tests using D. magna and D. pulex, and the effects of feeding on toxicity. The sensitivity of Daphnia and pH shock was also examined. Control survival was 90% or better in 84% of the tests, and 80% or better in 89% of the tests. Survival of controls in tests where the organisms were fed was slightly higher than when they were not fed. The precision of the method, expressed as the relative standard deviation (percent coefficient of variation or CV) of the 48-hr LC50, for each reference toxicant, SDS, PCP, and Cd, was 43.8, 35.7, and 20.9% for D. pulex and 28.9, 10.4, and 72.4% for D. magna, respectively. No statistically significant differences (P=0.05) were observed in 48-hr LC50 values obtained from paired tests with fed and unfed D. pulex exposed to PCP or Cd, or with D. magna exposed to SDS. However, the 48-hr LC50 values were significantly different for fed and unfed D. magna exposed to PCP or Cd. D. pulex and D. magna were equally sensitive to SDS and PCP, but D. magna was significantly more sensitive to Cd than D. pulex even though D. magna was tested in water of much greater hardness. Sudden changes in pH of not more than two pH units in the range of pH 5 to 9 resulted in no mortality over a six-day period. (Author's abstract)
W87-01294

SHORT-CUT CHRONIC TOXICITY ESTIMATES USING DAPHNIA MAGNA,

Monsanto Co., St. Louis, MO.
W. J. Adams, and B. B. Heidolph.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 87-103. 7 tab, 18 ref.

Descriptors: *Toxicity, *Daphnia, *Hazardous materials, *Water pollution effects, Testing procedures, Ecological effects, Cost analysis, Organic compounds.

The use of a partial life cycle test together with an application factor (AF) is a reliable way to estimate the traditional Daphnia magna 21-day geometric mean-maximum acceptable toxicant concentration (GM-MATC). Afs were determined for twelve different endpoints from 20 D. magna 21-day chronic tests by dividing the respective endpoints by the 21-day GM-MATC for each chemical. The data indicate that the 48-hr no-effect concentration, the 7-, 14-, and 21-day LC50 values, and the 7- and 14-day geometric mean no-effect/effect concentrations can be used with small AFs to reliably estimate the 21-day GM-MATC. The respective AFs are 2.9, 6.0, 2.0, 4.2, and 2.7. For purposes of ranking chemicals and obtaining preliminary estimates of environmental safety margins, the use of a 48-hr no-effect concentration from an acute toxicity test and an AF(33) is recommended as a cost effective way to estimate the chronic GM-MATC for D. magna. The results of this study indicate that there are only minor differences between 14- and 21-day GM-MATC. Therefore it is recommended that standard protocols for testing D. magna be changed to require only a 14-day period of exposure instead of 21 days. The results of this study also suggest that a chronic test as short as 7 days could be conducted without significant loss of accuracy. (Author's abstract)
W87-01295

NEW AQUATIC BIOASSAY TECHNIQUE USING WYEOMYIA SMITHII, THE PITCHER-PLANT MOSQUITO,

Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
D. Strickman.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 104-116, 5 fig, 2 tab, 21 ref.

Descriptors: *Bioassay, *Bioindicators, *Pollutant indentification, *Mosquitoes, Detergents, Pesticides, Fishkill, Heavy metals, Fish toxins, Hazardous materials.

A new bioassay using larvae of the pitcher-plant mosquito, Wyeomyia smithii, was used to assess water for the presence of toxic contaminants. Procedurally, the bioassay has the advantages of simplicity, minimum equipment requirements, and low maintenance. It is well suited for bioassays of water from remote sites because of the minimal amount of water (30ml) necessary for each replicate. The bioassay was capable of detecting 30 ppm of 1 Stroke Ves-Phene (a disinfectant detergent concentrate containing phenates), 5 ppb of heptachlor epoxide, and 100 ppb of melathion. In addition to reducing survival, toxicants caused delayed development and produced signs of intoxication unique to each substance. In another instance, the bioassay was used in the investigation of a fish kill. Persistence of toxicity, delayed development, and non-nervous signs of intoxication indicated which samples were contaminated and suggested that heavy metals were involved. Subsequent anal-

ysis revealed toxic levels of copper and elevated levels of zinc and manganese. (Author's abstract)
W87-01296

EFFECTS OF SMALL FISH PREDATION ON MICROCOSM COMMUNITY BIOASSAYS,
Washington Univ., Seattle. School of Fisheries.
M. C. Harrass, and F. B. Taub.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 117-133. 5 fig, 3 tab, 32 ref. FDA Contracts 223-76-8348, 223-80-2352.

Descriptors: *Predation, *Bioassay, *Toxicity, *Fish, Aquatic populations, Algicides, Testing procedures, Hazardous materials, Ecosystems, Zooplankton, Species composition, Ecological effects, Water pollution effects, Crustaceans, Food chains, Food habits.

The effect of fish predation on community composition and structure in chemical toxicity tests was examined in 65-L microcosms using four species of small fish (Gasterosteus aculeatus, Cottus asper, Poecilia reticulata, and Pimephales promelas). Predation was simulated by filtration of fixed proportions of the microcosms; no major changes were observed, which suggests that microcosm communities can tolerate removal of at least 25% of selected zooplankton populations per week. Results suggested that predation can be included in moderately sized microcosms only if exposure is restricted either by limiting the time of fish presence or by allowing the fish access to a limited portion of the microcosm. This restriction may be related to scaling factors, which suggest that natural communities have a lower fish biomass/community biomass than present in micorcosm communities, and to environmental heterogeneity, which provides necessary refugia for prey populations. Even with restrictions on predation, variability due to differences in fish behavior can be unacceptably great. Fish predation did not alter the ability to detect direct effects of a selective algicide (streptomycin) on the algae, but did reduce the ability to detect indirect effects on cladoceran and ostracod populations. (Geiger-PTT)
W87-01297

FACTORS AFFECTING GROWTH AND SURVIVAL OF THE ASIATIC CLAM, CORBICULA SP., UNDER CONTROLLED LABORATORY CONDITIONS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W87-01298

USE OF BIOCHEMICAL MEASUREMENTS TO DETECT POLLUTANT-MEDIATED DAMAGE TO FISH,
Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 5C.
W87-01300

EFFECT OF IRON AND ZINC INTERACTION ON ALGAL COMMUNITIES,
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5C.
W87-01301

SEDIMENT MICROBIAL ACTIVITY TESTS FOR THE DETECTION OF TOXICANT IMPACTS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-01303

METHOD OF ASSESSING THE TOXICITY OF CONTAMINATED FRESHWATER SEDIMENTS,
EG and G Bionomics, Wareham, MA. Aquatic Toxicology Lab.
G. A. LeBlanc, and D. C. Surprenant.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 269-283. 1 fig, 8 tab, 28 ref.

Descriptors: *Toxicity, *Bioindicators, *Sediments, *Water pollution effects, *Bioassay, *Minnows, Daphnia, Midges, Dredging, Wells, Hazardous materials, Ecological effects.

A test method was developed to assess the toxicity of freshwater dredged sediments. Toxicity of contaminated sediments was detected by monitoring survival and growth of fathead minnows (Pimephales promelas), emergence and egg hatchability of midges (Paratanytarsus parthenogenica), survival and reproduction of daphnids (Daphnia magna), and changes in microorganism populations. All organisms were exposed for 21 days in an apparatus that recirculated water through a compartment containing the sediments. In addition, a ranking scheme was proposed with which bulk sediment analyses for chemical contaminants could be condensed into a single value termed the hazard index. The hazard index was calculated for each sediment sample and was indicative of the degree of chemical contamination of the sediment. Sediments were classified as highly polluted, moderately polluted, or relatively nonpolluted, based on their hazard index. Eighty-six dredged sediment samples were tested. All biological parameters measured, except midge egg hatchability, were instrumental in detecting toxicity associated with the sediments. Effects were observed with 74% of the highly polluted sediments, 38% of the moderately polluted sediments, and 36% of the relatively nonpolluted sediments. The sublethal parameters measured were important indicators of toxicity. (Author's abstract)
W87-01306

PHOXOCEPHALID AMPHIPOD BIOASSAY FOR MARINE SEDIMENT TOXICITY,
Environmental Research Lab., Narragansett, RI. Ocean Discharge Div.
R. C. Swartz, W. A. DeBen, J. K. P. Jones, J. O. Lamberson, and F. A. Cole.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 284-307. 1 fig, 6 tab, 45 ref, append.

Descriptors: *Amphipods, *Bioassay, *Marine sediments, *Toxicity, *Water pollution effects, Ecological effects, Assay, Animal behavior, Crustaceans, Hazardous materials, Ocean dumping, Dredging, Environmental effects.

The relative toxicity of marine sediment can be accurately determined through acute, static bioassays with the phoxocephalid amphipod Rhepoxynius abronius. Mortality and sublethal effects on emergence from sediment and reburial behavior are determined after a ten day exposure in 1-liter beakers containing 175 ml of test sediment, 775 ml of seawater (25 ppt, 15 C), and 20 amphipods. Response of amphipods to test sediment is compared with response in control sediment collected from the species' natural habitats. Mean survival under control conditions is 95%. With five replicates the bioassay is 75% certain of detecting statistical significance when mean survival is reduced by 15%. The method can be applied to a great variety of sediment types because of the tolerance of R. abronius to a broad range of sediment grain sizes and levels of organic enrichment. The bioassay can be applied to determine the toxicity of sediment subject to regulatory decision (e.g., dredging or disposal), the spatial distribution of sediment toxicity along pollution gradients or near point sources, and the LC50 of contaminants added to unpolluted sediment. The species' sensitivity to low salinity limits the method to sediments from the coastal zone and lower portion of estuaries. A detailed description of the bioassay procedures is appended. (Author's abstract)
W87-01307

STATISTICAL TEST PROCEDURE FOR EFFLUENT TOXICITY SCREENING,
SCI Data Systems, Inc., Annapolis, MD.
P. D. Mowery, J. A. Fava, and L. W. Claflin.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 308-318. 4 fig, 3 tab, 4 ref.

Descriptors: *Testing procedures, *Bioassay, *Water pollution effects, *Toxicity, Statistical analysis, Effluents, Data interpretation, Statistics, Mathematical studies.

This paper discusses the screening of effluent toxicity by comparing survival proportions between effluent-treated and control groups of test organisms. If the effluent is nontoxic, survival proportions should be similar for both groups. However, because of differences in sensitivity of individual test organisms, these proportions will not necessarily be identical. Futhermore, the number of organisms surviving from test to test will vary, even though identical effluent samples and identical laboratory procedures are used for all tests. This paper describes a statistical test for determining when effluent and control group survival proportions are significantly different, thereby indicating a potentially toxic effluent. The paper emphasizes the statistical power of the test for detecting effluents of various toxicities. It also evaluates the probability that an effluent will be incorrectly judged to be toxic. The four key statistical parameters that determine the usefulness of the test are described: statistical power (i.e., the probability of incorrectly judging an effluent to be toxic); effect size (i.e., the true but unknown difference between effluent and control long-run survival proportions); and sample size. (Graphs showing the relationships between these four parameters are included). As the number of organisms used in the test is increased, the power of the test also increases. An experimental design procedure using this test and the statistical power-sample size tradeoff is also determined. (Author's abstract)
W87-01308

ISOLATION AND CHEMICAL CHARACTERIZATION OF PETROLEUM REFINERY WASTEWATER FRACTIONS ACUTELY LETHAL TO DAPHNIA MAGNA,
Enwright Labs., Greenville, SC.
C. N. Reece, and S. L. Burks.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 319-332. 1 fig, 8 tab, 22 ref.

Descriptors: *Pollutant identification, *Industrial wastes, *Bioassay, *Daphnia, *Water pollution effects, Separation techniques, Gas chromatography, Mass spectrometry, Assay, Aromatic compounds, Hydrocarbons, Toxicity, Hazardous materials, Ecological effects.

Daphnia magna static bioassays were used to characterize the relative toxicity of each fraction of a petroleum refinery wastewater. Steam stripping the wastewater concentrated the toxicity in a volatile fraction. Activated carbon filtration removed the toxicity but cation exchange did not, indicating that organics are the toxic agents. Methylene chloride extraction of the volatile portion at pH > 11 followed by silica gel column chromatography resulted in an aromatic residue which was acutely toxic when dissolved in culture water. The combination of selected fractionation followed by Daphnia bioassays of each fraction determined the characteristics of the most toxic fraction to be steam volatile, base-neutral, and aromatic. Eleven compounds (polycyclic aromatic hydrocarbons) with a total concentration of 1100 micrograms/L and accounting for 28% of the total peak area of the chromatogram were identified in the aromatic fraction by a gas chromatograph/mass spectrometer. The mass spectra of the unidentified compounds indicated that they were probably nonhalogenated heterocyclics with molecular weights of 180 to 300, containing nitrogen, oxygen, or sulfur atoms. Some of the unidentified compounds appeared to be hydroxylated forms of the parent compounds which were identified. (Author's abstract)
W87-01309

OVERVIEW OF BIOLOGICAL EFFECTS TESTING IN PUGET SOUND, WASHINGTON: METHODS, RESULTS, AND IMPLICATIONS,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W87-01311

USING THE NATURAL DETOXIFICATION CAPACITIES OF MARINE ORGANISMS TO ASSESS ASSIMILATIVE CAPACITY,
Southern California Coastal Water Research Project Authority, Long Beach.
D. A. Brown, S. M. Bay, and R. W. Gossett.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 364-382. 7 fig, 2 tab, 64 ref. NOAA/OMPA Grants NA80RAD00040 and NA82RAD00003.

Descriptors: *Bioassay, *Toxicity, *Marine animals, *Assimilative capacity, *Water pollution effects, Fish, Echinoderms, Organic compounds, Heavy metals, Cadmium, Copper, Zinc, Enzymes, Liver, Kidneys, Gills, Fish physiology, Metabolism, Detoxification, Decontamination, Marine sediments, California.

A test for determining the toxicity of contaminants in the environment is proposed which is based on the assimilative capacity of organisms for contaminants during detoxification. Toxic effects of contaminants appear to coincide with saturation of in vivo detoxification systems with metal or organic contaminants and appearance of these contaminants at intracellular sites of toxic action. A simple gel chromatography procedure has been devised to determine the intracellular partitioning of contaminants between an enzyme-containing pool which is a site of toxic action for both metals and organic compounds, a metallothionein-containing (MT) pool which is a site of detoxification for metals, and a glutathione-containing (GSM) pool which is a site of detoxification for organic compounds. Partitioning of contaminants between intracellular pools was determined for sea urchins, scorpion fish, croakers, and Dover sole living near and away from a major California municipal wastewater outfall. Cd, Cu, and Zn appeared to be detoxified by the MT pool in all field-exposed organisms. Cd detoxification capacity in tissues of scorpion fish was in the relative sensitivity or of kidney>gills>intenstine>liver. Oxygenated metabolites appeared to have exceeded the capacity of GSM pool in field-exposed croakers and Dover sole, with fatty livers and fin erosion, respectively. Sediments and their associated microorganisms may also have a measurable capacity to detoxify contaminants by binding them and making them unavailable or by degrading them to nontoxic forms. (Author' abstract)
W87-01312

EXTRAPOLATING FROM THE LABORATORY TO THE FIELD: HOW UNCERTAIN ARE YOU,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-01314

AQUATIC HAZARD EVALUATION PRINCIPLES APPLIED TO THE DEVELOPMENT OF WATER QUALITY CRITERIA,
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5G.
W87-01323

ROLE OF PHYTOTOXICITY TESTS IN THE DERIVATION OF NUMERICAL NATIONAL WATER QUALITY CRITERIA,
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5G.
W87-01324

EVALUATION OF A SITE-SPECIFIC WATER QUALITY CRITERION FOR PENTACHLOROPHENOL USING OUTDOOR EXPERIMENTAL STREAMS,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
For primary bibliographic entry see Field 5G.
W87-01325

ADJUSTMENT-EQUATIONS TO CALCULATE ION-CONCENTRATIONS, ILLUSTRATED BY CERTAIN GAUGING STATIONS OF THE RIVER WESER (ANSAETZE ZUR KALKULATION VON IONENKONZENTRATIONEN, DARGESTELLT FUER AUSGEWAEHLTE MESSSTATIONEN DER WESER),
Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
W. Walther, D. Bock, M. Gorsler, J. Poltz, and K. Korn.
Zeitschrift Wasser und Abwasser ZWABAQ, Vol. 18, No. 6, p 250-253, December 1985. 5 fig, 2 tab, 8 ref.

Descriptors: *Mathematical equations, *Lower Saxony, *Weser River, *Germany, *Electrolytes, *Computer programs, Conductivity, Water pollution, Chemical analysis, Potassium, Chlorides, Sulfates, Mine wastes, Ions.

In Lower Saxony (Germany, F.R.), gauging stations are installed along those rivers deemed important in view of water resource policy. The river Weser is highly polluted by potash mine wastes. For water survey and water resource planning purposes, continuous information is needed about the fluctuation over time of salt components. Equations derived from the theory of electrolytes allowed the computation of ion concentrations on the basis of continual conductivity measurement. Data from one station from 1981 and 1982, used as the basis for a calculation, closely predicted the average values and average relative standard deviations for concentrations of Cl(-) and K(+) actually measured in 1983. The equations gave more exact calculation results for Ca(2+) and SO4(2-) than those achieved by a computer program currently in use in lower Saxony. (Airone-PTT)
W87-01337

TOC-, TIC-, AND TC-INVESTIGATIONS OF MATERIALS FOR CONTACT WITH POTABLE WATER, (TOC-, TIC-, UND TC-BESTIMMUNGEN AN WERKSTOFFEN FUER DEN TRINKWASSERBEREICH),
Bonn Univ. (Germany, F.R.). Hygiene Inst.
D. Schoenen.
Zeitschrift Wasser und Abwasser ZWABAQ, Vol. 18, No. 6, p 254-257, December 1985. 4 fig, 15 ref.

Descriptors: *Organic carbon, *Drinking water, *Chlorinated hydrocarbons, *Water pollution sources, Coatings, Plasticizers, Inorganic carbon, Polymers, Chemical analysis, Potable water.

Materials which come into contact with potable water should be chemically and microbiologically tested to limit degradation of water quality. Among the chemical tests, the TOC-measurement (Total Organic Carbon) is quite important. Observations showed that materials which produced an intense increase in microorganisms in the TOC test produce hardly any increase in the concentration of organic compounds in the water. A contradiction results. The increase in microorganisms is supported by the organic compounds which are released from the materials. A solvent-containing chlorinated rubber coating and a plasticizer-containing PVC film were tested. In the TOC test, easily volatilized substances such as the solvents of the coating and water insoluble substances such as the phthalate plasticizers could not be accurately determined. (Airone-PTT)
W87-01338

TITRATION OF AQUATIC HUMIC SUBSTANCES AND THEIR CALCIUM COMPLEXES WITH STRONG ACIDS AND BASES, (TITRATION ISOLIERTER AQUATISCHER HUMINSTOFFE UND IHRER CALCIUM-KOMPLEXE MIT STARKEN BASEN UND SAUREN),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 5B.
W87-01339

PRACTICAL APPLICATION OF THE EQUIVALENCE TEST USING THE DETERMINATION OF NITRATE AND NITRITE IONS AS AN EXAMPLE, (DIE PRAKTISCHE ANWENDUNG DES GLEICHWERTIGKEITSTESTES AM BEISPIEL DER BESTIMMUNGEN DER NITRAT- UND NITRIT-IONEN),
A. Wilhelms, and W. Funk.
Zeitschrift Wasser und Abwasser ZWABAQ, Vol. 18, No. 6, p 263-272, December 1985. 6 fig, 13 tab, 10 ref.

Descriptors: *Statistical methods, *Nitrates, *Nitrites, *Equivalence test, *Wahnbach, Standards, Chemical analysis, Autoanalyzers, Drinking water, Groundwater, Surface water.

In the laboratories of the Wahnbach Reservoir Association, the analytical procedures determining nitrate and nitrite ions according to German Standards (DIN) were compared with the corresponding automated analytical methods to determine their equivalence. The results of both analytical procedures following calibration, repeated determinations and standard addition were compared. The automated analytical procedures are superior to DIN methods not only by virtue of better reproducibility, but also because they can be performed in less time (particularly when conducting a series of analyses). The results of a ring test for the determination of nitrate ions are also given. (Author's abstract)
W87-01340

SIZE FRACTIONATION TECHNIQUES IN THE DETERMINATION OF ELEMENTS ASSOCIATED WITH PARTICULATE OR COLLOIDAL MATERIAL IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-01415

DETERMINATION OF CHROMIUM IN TREATED CRAYFISH PROCAMBARUS CLARKII, BY ELECTROTHERMAL AAS: STUDY OF CHROMIUM ACCUMULATION IN DIFFERENT TISSUES,
Valencia Univ. (Spain). Dept. of Analytical Chemistry.
F. Hernandez, J. Diaz, J. Medina, J. Del Ramo, and A. Pastor.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 851-857, June 1986. 2 fig, 1 tab, 15 ref.

Descriptors: *Chromium, *Path of pollutants, *Chemical analysis, *Bioconcentration, *Crayfish, *Procambarus clarkii, *Tissue analysis, Electrothermal atomic absorption spectrometry, Wastewater, Spain.

The present study investigates the accumulation of chromium in muscle, hepatopancreas, antennal glands, and gills of Procambarus clarkii from Lake Albufera (Valencia, Spain) following Cr(VI)-exposure. Adult intermolt specimens of crayfish were collected and transferred to aquaria for 10 days and maintained before treatment. The crayfish were then divided into groups and exposed to Cr for 96 hours. Animals were transferred to clean water and kept there for an additional 5 hours. The gills, hepatopancreas, antennal glands, and tail muscle of the control and the treated crayfish were dissected. Prior to analysis the tissues were lyophilized, homogenized, and digested. Samples were analyzed by atomic absorption spectrophotometry. Chromium concentration in tissues increased linearly when the chromium concentration of the test solution increased. Animals at higher Cr-concentrations continued to accumulate chromium. The relative accumulation rate decreased with increasing contamination, especially in the gills and the hepatopancreas. The crayfish presented a high capacity for chromium accumulation. Because they

are being utilized for human consumption, the use of sanitary conditons for raising these crustaceans is recommended. (Main-PTT)
W87-01425

MODIFIED MULTIRESIDUE METHOD FOR CHLORDANE, TOXAPHENE, AND POLYCHLORINATED BIPHENYLS IN FISH,
Michigan Dept. of Public Health, Lansing. Center for Environmental Health Sciences.
H. A. Price, R. L. Welch, R. H. Scheel, and L. A. Warren.
Bulletin of Environmental Contamination and and Toxicology BECTA6, Vol. 37, No. 1, p 1-9, July 1986. 5 fig, 6 tab, 16 ref. EPA Grant CS-807912010.

Descriptors: *Chlordane, *Toxaphene, *Fish, *Polychlorinated biphenyls, DDT, DDE, Toxins, Pesticides, Sport fish, Lake Michigan, EPA methods, Gas chromatography.

For studies of human exposure to environmental contaminants due to consumption of Lake Michigan sport fish, a semimicro analytical procedure that eliminates the need for acetonitrile partitioning for cleanup of fish extracts was developed. The modifications of the usual procedure are described in the text, including silica gel column chromatography to achieve additional cleanup of the 6% Florisil fraction and separation of PCBs from chlorinated pesticides. The method described for the analysis of fish sample exhibits high recoveries of chlorinated pesticides and PCBs without requiring liquid-liquid partitioning. One disadvantage is that low molecular weight PCBs such as Aroclor 1016 do not separate sharply and another is the presence of p,p'-DDE in two silica gel fractions. (Main-PTT)
W87-01430

INDICATOR VALUE OF THE GENUS EPISTYLIS (CILIATA),
Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
For primary bibliographic entry see Field 5D.
W87-01460

SCREENING OF ORGANIC MATTER IN LEACHATES FROM SANITARY LANDFILLS USING GAS CHROMATOGRAPHY COMBINED WITH MASS SPECTROMETRY,
State Chemical Supervision Service, Soeborg (Denmark).
B. Schultz, and P. Kjeldsen.
Water Research WATRAG, Vol. 20, No. 8, p 965-970, August 1986. 4 fig, 4 tab, 12 ref.

Descriptors: *Organic matter, *Leachates, *Sanitary landfills, *Pollutant identification, Gas chromatography, Mass spectrometry, Denmark, Pesticides, Benzene, Toluene, Carboxylic acids, Aromatic compounds, Alkylbenzenes, Trichloroethylene, Path of pollutants, Groundwater pollution.

Sanitary landfills are potential groundwater pollution sources, normally producing leachate with very high content of organic matter. Leachates from five Danish sanitary landfills were sampled to investigate the composition of the organic matter. The samples were extracted using dichloromethane followed by sodium hydroxide solution, to divide the sample into one phase containing the basic and neutral compounds and one containing the acidic compounds. One of the leachates was extracted using pentane for analysis of volatile compounds. The three extracts were analyzed using gas chromatography combined with mass spectrometry. Several compounds were identified, including chlorinated pesticides (2 of 5 leachates), aromatic carboxylic acids and alkylbenzenes. Benzene, toluene and trichloroethylene were found in the leachate analyzed for volatile compounds. Some of the compounds identified have been reported in the literature to give rise to severe groundwater problems. (Author's abstract)
W87-01464

VIRUS RECOVERY FROM WASTEWATER TREATMENT PLANT SLUDGES,
Nancy-1 Univ. (France). Faculte des Sciences Pharmaceutiques et Biologiques.
L. Schwartzbrod, and C. Mathieu.
Water Research WATRAG, Vol. 20, No. 8, p 1011-1013, August 1986. 1 tab, 19 ref.

Descriptors: *Viruses, *Pollutant identification, *Sludges, Wastewater treatment, Enteroviruses, Culturing techniques, Culture media, Microbiological studies.

A virus extraction method which combines elution with a 10% beef-extract with agitation and sonication, was used to recover enteric viruses from 4 types of sludge sampled at a treatment plant, and from 2 types of stored sludge. Titers were measured using BGM continuous cell line with the plaque technique. No viruses were recovered from any of the 16 stored sludge samples analyzed. All samples of fresh mixed sludge and of activated sludge contained viruses. Forty-five percent of digested sludge and 10% of dehydrated sludge samples were positive for virus. (Author's abstract)
W87-01470

SPECTROPHOTOMETRIC STUDY OF THE FORMATION OF AN UNIDENTIFIED MONOCHLORAMINE DECOMPOSITION PRODUCT,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
R. L. Valentine, K. I. Brandt, and C. T. Jafvert.
Water Research WATRAG, Vol. 20, No. 8, p 1067-1074, August 1986. 15 fig, 3 tab, 18 ref.

Descriptors: *Spectrophotometry, *Monochloramine, *Path of pollutants, *Decomposition, *Water treatment, Pollutant identification, Chloramines, Drinking water, Potable water, Hydrogen ion concentration.

The formation of an unidentified product(s) by the slow decomposition of monochloramine was studied in organic free aqueous solutions at pH values and Cl/N ratios of importance in the chloramination disinfection of drinking water. Chloramine and total oxidant concentrations determined spectrophotometrically in these solutions became significantly greater with time than those determined by a titrimetric method, due to the absorbance of the unidentified product(s). The u.v. spectra of the product(s) was calculated from the difference between measured and predicted spectra and was similar to that obtained in a chloramine free solution resulting from the rapid decomposition of dichloramine at high pH. No spectrophotometric evidence could be found for the formation of significant concentrations of nitrite and/or nitrate. Relative concentration changes of the unidentified product(s) as measured by its calculated absorbance at 243 nm showed that the product(s) accumulates with time and therefore is not likely to be an intermediate in the formation of nitrogen gas. Both increased pH and phosphate buffer increased its formation rate. A formation mechanism involving the decomposition of dichloramine is suggested. Findings suggest that the age/history of chloramine solutions could be an important variable in toxicological studies of chloramines and their reaction products depending on the health effects of the unidentified product(s). (Author's abstract)
W87-01478

DETERMINATION OF COBALT IN NATURAL WATERS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY AFTER MICRO SOLVENT EXTRACTION WITH CAPRIQUAT,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
T. Shimizu, H. Koyanagi, Y. Shijo, and K. Sakai.
Chemistry Letters CMLTAG, No. 3, p 319-322, March 1986. 1 tab, 9 ref. Ministry of Education, Science and Culture (Japan) Grant in aid 60030008.

Descriptors: *Water analysis, *Cobalt, *Atomic absorption spectrometry, *Capriquat, Spectral analysis, Photometry, Heavy metals.

A simple and rapid preconcentration method for the determination of trace elements in natural waters has been required because of increasing concern over environmental pollution. The cobalt content of natural water is often below microgram/l, and sometimes at nanogram/l level, so that its determination, even by graphite furnace atomic absorption spectrometry (GFAAS), requires about a thousand fold preconcentration. Cobalt is extracted as the thiocyanato complex with trioctylmethylammonium chloride (Capriquat) in o-dichlorobenzene, and determined by graphite furnace atomic absorption spectrometry using a pyrolytic coated tube. At the sampling point, the proposed method was applied. The organic phase separated was stored in a refrigerator, and determined in the laboratory within a day. (Khumbatta-PTT)
W87-01501

GEOCHEMISTRY AND AQUEOUS CHEMISTRY OF ALUMINUM,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1B.
W87-01502

EVALUATION OF THE VIRAL POPULATION IN TWO WASTEWATER TREATMENT PLANTS: STUDY OF DIFFERENT SAMPLING TECHNIQUES,
Nancy-1 Univ. (France).
For primary bibliographic entry see Field 5D.
W87-01547

BIOASSAYS WITH STIGEOCLONIUM TENUE KUTZ. ON WATERS RECEIVING SEWAGE EFFLUENTS,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
P. J. R. De Vries, and E. J. Hotting.
Water Research WATRAG, Vol. 19, No. 11, p 1405-1410, 1985. 5 fig, 3 tab, 23 ref.

Descriptors: *Bioassay, *Stigeoclonium, *Wastewater, *Water quality control, *Monitoring, Chlorophyta, Algae, Bioindicators, Assay, Nitrogen, Phosphorus, Quality control.

Stigeoclonium tenue (Chlorophyceae) was tested as a bioassay organism on water receiving effluents of two sewage treatment plants. The PO4-P and NH4-N concentration declined with increasing distance from the effluent discharge. Growth potentials were low and inhibited in assays with undiluted effluents, and relatively high at some distance from the points of discharge. At greater distances, growth potentials tended to decrease with increasing distance from the plants. Nitrogen or phosphorus limitation could be determined at distant sites. When ratios of inorganic nitrogen to inorganic phosphorus were lower than 7, nitrogen was primary limiting; at ratios above 10, phosphorus became the limiting factor. Possible growth-inhibiting factors in the effluents are discussed. (Author's abstract)
W87-01554

IDENTIFICATION OF HIGHLY CHLORINATED ETHERS AND DIETHERS IN RIVER SEDIMENT NEAR AN EPICHLOROHYDRIN PLANT,
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
E. W. B. de Leer.
Water Research WATRAG, Vol. 19, No. 11, p 1411-1419, 1985. 4 fig, 2 tab, 13 ref.

Descriptors: *Chlorinated ethers, *Chlorinated diethers, *Sediments, *Rivers, *Chemical wastes, *Epichlorohydrin, Chemical reactions, Industrial wastes, Organic compounds, Chemical analysis, Pollutant identification.

A series of highly chlorinated ethers and diethers were detected in harbor sediment samples taken near an epichlorohydrin production plant. These consisted of three isomeric bis(dichloropropyl)ethers, several structurally closely related ethers with nine carbon atoms (C9 ethers), a number of C12 ethers and diethers, and finally several C15 ethers. This environmental con-

tamination is caused by dumping of CaCl2 sludges which result from the Ca(OH)2 reaction step in the production of epichlorohydrin. The chlorinated ethers detected were the result of side reactions of the carbenium ion intermediates which are formed during the addition of chlorine to allylchloride in aqueous medium. Direct reaction of these intermediates with dichloropropanol gives the C6-ethers, while polymerization with the excess of allylchloride followed by reaction with dichloropropanol gives the C9 and C12 monoethers. Several C12 and C15 diethers were tentatively detected, which could not be specifically identified. (Doria-PTT)
W87-01555

EFFECT OF TEMPERATURE ON THE FORMATION OF INDOPHENOL BLUE IN A SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF AMMONIA,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
B. M. Stewart.
Water Research WATRAG, Vol. 19, No. 11, p 1443-1445, 1985. 4 fig, 12 ref.

Descriptors: *Temperature, *Indophenol blue, *Spectrophotometry, *Chemical analysis, *Ammonia, *Water analysis, Photometry, Nitrogen.

Temperature was found to be an important factor in a modified Berthelot reaction used for the spectrophotometric determination of ammonia in freshwaters. The effect of temperature on the reaction was investigated over the range 4.5-55 C, and it was shown that the rate of color formation increased with increasing temperature, accompanied, however, by a significant decrease in the sensitivity of the method. The initial temperature of the reaction on mixing of reagents was shown to determine the final absorbence of the solution. Any further increase in temperature only decreased the time to reach maximum absorbence. (Author's abstract)
W87-01559

DEPOSITION CHEMISTRY DETERMINED VIA SULFUR AND IRON AS INDICATORS,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Lab. of Inorganic Analytical and Nuclear Chemistry.
For primary bibliographic entry see Field 2K.
W87-01567

DETERMINATION OF PHTHALATES IN AQUATIC ENVIRONMENTS,
Lund Univ. (Sweden). Lab. of Ecological Chemistry.
A. Thuren.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No 33-40, January 1986. 2 fig, 3 tab, 17 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Phthalates, *Aquatic environment, *Contamination, Gas chromatography, Water analysis, Chromatography, Industrial wastes, Pollutants, Sediments.

A gas chromatographic method was developed for determining phthalates in water, sediment, and organisms and for reducing background contamination. The method was tested on samples from two rivers in southern Sweden near industries using phthalates. Phthalates eluted from the column in the order dimethylphthalate (DMP), dibutylphthalate (DBP), benzoylbutylphthalate (BBP), di(2-ethylhexyl)phthalate (DEHP). Detector response was linear betwe 100 ng. Detection limit was 0.05 ng for BBP and 0.1 ng for the other phthalates. Recovery ranged from 25-30% for DMP, 60-70% for DBP, 60-130% for BBP, and 80-90% for DEHP. Background value did not exceed 100 ng DEHP; 50% of this contamination originated from the organic solvents. It was found that solvents and chemicals needed for elution could be decreased by a factor of 10 without decreasing recovery. (Doria-PTT)
W87-01573

PRODUCTION QUOTIENT PQ: A NEW APPROACH FOR QUALITY DETERMINATION OF SLIGHTLY TO MODERATELY POLLUTED RUNNING WATERS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
A. Frutiger.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 513-526, October 1985. 3 fig, 1 tab, 24 ref.

Descriptors: *Productivity, *Qualitative analysis, *Water quality control, *Running waters, Water pollution control, Biocoenosis, Switzerland, Ecological effects, Nitrites, Dissolved organic carbon, Chlorides.

This approach for the qualitative determination of running waters, is based on two generally known principles, i.e., that a natural, undisturbed biotic community in climax condition is energetically optimized, and that any type of disturbance is more prejudicial to higher trophic level animals than to those of a lower level. Thus, the production quotient between the higher and lower trophic level increases, and can therefore be used as a measure of the intactness of the biocoenosis, and consequently also for the quality of their habitat. For quality determination of running water biocoenosis, the production quotient (PQ) between the primary (PII) and secondary consumers (PIII) is particularly suitable. The PQ is approximately 15 in undisturbed biocoenosis and increases the greater the disturbance. If this approach is applied on the data obtained from monthly investigations carried out over a period of 2 years, in 16 slightly to moderately polluted Swiss rivers, a strong and highly significant correlation is observed between PQ and the four pollutants NO2(-), NO3(-), DOC and Cl(-) (the mean value of the four correlations lies at 0.78). Since this approach is based only on biological measurements, the results obtained are chemically independent but complementary. Its application is particularly interesting in rivers where the determined PQ differs from the expected value obtained on the basis of chemical results. (Author's abstract)
W87-01601

SAMPLING GROUND WATER FOR VOLATILE ORGANIC COMPOUNDS: THE EFFECTS OF SAMPLING METHOD, COMPOUND VOLATILITY AND CONCENTRATION,
J. P. Unwin.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 214-220, 3 fig, 8 tab, 6 ref.

Descriptors: *Water sampling, *Groundwater pollution, *Volatile organics, *Organic compounds, Sample preparation, Water quality control, Pumps, Vacuum flask.

Three factors appear to exert influence on the quality of groundwater. A study was designed to examine the effects of (a) the sampling device or principle, (b) the volatility of the chemical compound, and (c) the compound's concentration. The vacuum flask technique for groundwater sampling can cause relatively high losses of volatile organic compounds from samples. The bailer, the gas-operated, squeeze-type submersible pump and the Johnson-Keck electric submersible pump, all cause significantly lower losses of volatiles from samples than does the vacuum flask techniques. There is no evidence that the bailer and the squeeze pump perform differently when sampling groundwater for volatile organic compounds, and there is little evidence (i.e. statistically lower losses with the gas-squeeze pump compared to the Johnson-Keck pump in the low-concentration run) of any differences at all between the three devices that did well. It appears that the greater the volatility of the compound, the greater the percent loss of that compound due to sampling, especially with the vacuum flask device. There is no evidence of an effect on the percent loss of volatile organics from samples represented by the two runs in this experiment. However, there is weak evidence of an effect on the precision of sampling with precision dropping as concentration rises. (See also W87-01669) (Lantz-PTT)
W87-01693

PRESERVING THE CHEMICAL INTEGRITY OF A GROUND WATER SAMPLE,
Residuals Management Technology, Inc., Madison, WI.
T. Stolzenburg, and D. G. Nichols.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 221-225, 5 fig, 1 ref.

Descriptors: *Sample preservation, *Chemical composition, *Groundwater quality, *Water sampling, Hydrogen ion concentration, Carbon dioxide, Oxidation, Chemical precipitation, Adsorption, Iron, Simulation analysis, Chemical analysis, Filtration.

One of the challenges faced during sampling from a well is to preserve the chemical integrity of the sample from the time it enters the sampling device, to the time of analysis. Chemical changes that can occur include degassing of CO2, rising pH, loss of volatiles, oxidation, precipitation and adsorption. In the case of iron, if groundwater is in a reduced condition, the action of sampling can cause oxidation of dissolved ferrous iron and rapid precipitation of ferric hydroxide. A filtered sample will then exhibit a dissolved iron concentration that greatly underestimates the amount of iron in the groundwater. A consequence of ferric hydroxide precipitation is the adsorption from the solution of other trace metals as either cations or anions. This phenomenon was reproduced in the lab and various groundwater sampling devices were tested for aeration. The apparatus for simulating groundwater sampling consists of an 8-foot, 4-inch diameter well casing centered in a 7-foot high, 15-inch diameter cell. The cell is constantly purged with solution containing reduced iron and the cations or anions of interest. Sampling was conducted with and without in-line filtration. The observed increase in filterable iron when in-line filtration was used, indicates that most aeration and subsequent iron loss occur if a sample is introduced to a holding vessel prior to filtration. (See also W87-01669) (Lantz-PTT)
W87-01694

REMOTE ANALYSIS OF GROUND WATER CONTAMINANTS USING LASER FLUORESCENCE,
Tufts Univ., Medford, MA. Dept. of Chemical Engineering.
W. A. Chudyk, and J. E. Kenny.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 235-243, 10 fig, 3 tab, 22 ref. NSF Grant No. PRM-8114621 (WAC).

Descriptors: *Remote analysis, *Groundwater pollution, *Chemical analysis, *Laser fluorescence, In situ tests, Fiber optics, Wavelengths, Organic compounds, Phenols, Humic acid, Leachates, Toluene, Xylene, Filtration.

A method for direct in situ monitoring of certain common organic groundwater contaminants uses a laser source, fiber optics and a detector to remotely measure contaminants. The laser light source causes many aromatic organic compounds to fluoresce some of the light energy adsorbed, typically at a longer wavelength than the exciting wavelength. This method of laser fluorescence detection using fiber optics is a promising new tool for groundwater monitoring. The variety of benzenoid compounds and mixtures measurable is impressive. The following specific conclusions can be made: (1) Phenol, ortho-cresol, humic acid, landfill leachate and bark leachate can be detected at ppm to ppb levels in a model 25m-deep well. Limits of detection are expected to be lower at shallower well depths, and are a function of compound or mixture type. (2) Ortho-chlorophenol. para-nitrophenol, toluene and xylenes all show promise as being detectable by this system. Further investigation is needed to document limits of detection and fluorescent characteristics of these and other con-

taminants. (3) Limited qualitative estimations should be possible when mixtures of contaminants contain species that are far enough apart in their emission spectra to permit signal separation, via selection of appropriate cutoff filters. In any case, cutoff filters are adequate to screen out scattered laser light as well as water Raman signals. In situ measurements of aromatic groundwater contaminants using this method, should allow early detection of contaminant plumes as they exist a disposal site or as they enter a water supply well field. Permanent installation of fiber optics in appropriate locations should allow baseline monitoring of groundwater quality . Changes in the fluorescence signal from the baseline will then indicate changes in contaminant concentrations. At such time, other more expensive exhaustive analyses of groundwater samples could reveal the exact nature of any problem. This method is attractive since it would indicate when an expensive analysis is needed. In conjunction with specific conductance, it is expected that this method will prove valuable as an early tool in groundwater monitoring. (See also W87-01669) (Lantz-PTT)
W87-01696

STRADDLE PACKER SAMPLING AND TESTING OF WELLS COMPLETED IN TRIASSIC ROCKS OF PENNSYLVANIA,
Ground Water Associates, Inc., Arlington, MA.
P. G. Sutton.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 244-254, 9 fig, 10 tab.

Descriptors: *Straddle packers, *Water sampling, *Groundwater quality, *Observation wells, *Pennsylvania, *Triassic rocks, Lansdale, Fracture zones, Pump testing, Volatile organics, Organic compounds, Trichloroethylene, Tetrachloroethylene, 1,1,1-trichloroethane, Path of pollutants.

Inflatable straddle packers were used for sampling and pumping tests of two contaminated wells (L-8 and L-9) completed in the Triassic-aged, fractured, consolidated Brunswick formation in Landsdale, Pennsylvania. Packer testing was conducted to sample discrete fracture zones and to determine the relative hydraulic characteristics of each fracture zone. Packer testing included constant rate pumping tests of each fracture zone in L-8 and constant head pumping of each zone in L-9. Volatile organic contaminants were present in all fracture zones sampled. Significantly greater concentrations of contaminants were present in the most permeable zones. The major volatile organic contaminants included trichloroethylene (TCE), tetrachloroethylene (PCE), and 1,1,1-trichloroethane (1,1,1-TCA). The most contaminated zones in each well contained 700 micrograms/L and 38 micrograms/L TCE respectively. Straddle packer testing was effective for sampling discrete fracture zones, identifying the most contaminated zones, and determining the relative water bearing characteristics of these zones. Packer testing enabled the determination of the head distribution between fracture zones, and aided in the delineation of local from regional flow systems. The information gained from packer testing should be very useful in the design and installation of monitoring and retrieval wells, and delineating the extent of contamination in local and regional groundwater flow system in fractured consolidated aquifers. (See also W87-01669) (Lantz-PTT)
W87-01697

SAMPLING PROCEDURES FOR THE BISCAYNE AQUIFER PROTECTION STUDY,
T. C. Emenhiser, R. J. Brunner III, N. N. Hatch Jr., and U. P. Singh.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 255-262, 2 fig, 4 tab, 7 ref.

Descriptors: *Sample preparation, *Groundwater quality, *Biscayne Aquifer, *Water quality control, Miami, Florida, EPA, Drinking water, Observation wells, Monitoring, Water sampling, Volatile organics, Organic compounds, Pumps, Inorganic compounds, Chemical analysis.

The Biscayne aquifer is the sole source of drinking water for the greater Miami metropolitan area. The aquifer is Florida's highest priority for EPA Superfund assistance. Previous monitoring well sampling conducted in the area revealed the sporadic presence of numerous priority pollutants. In an attempt to obtain comprehensive area-wide data, a sampling program was developed for EPA that included a total of 120 monitoring wells located near the Miami International Airport, an unsewered industrial area in the northwest, and Miami's 58th Street Landfill. In addition, samples were collected from 29 of Dade County's production wells. A total of six replicate samples were obtained from each monitoring well during the historic wet- and dry-season periods of November 1982 and March 1983, respectively. All sampling procedures were performed in accordance with EPA guidelines. Samples for volatile organics were collected with a stainless steel bailer that was cleaned with methanol and organic-free water prior to each use. Well samples for base/neutral and acid extractable organic compounds, phenolics, cyanide and metals were obtained with a peristaltic pump/Teflon manifold and tubing apparatus. The quality assurance program consisted of collection of several different types of field blank samples, as well as split samples, for analyses. The samples were analyzed for various organic and inorganic constituents in accordance with the EPA National Hazardous Waste Contract Laboratory protocols. EPA national chain-of-custody procedures, including the completion of organic and inorganic traffic reports and custody forms, were adhered to throughout the sampling program. Analytical results indicate that widespread low to moderate levels of several toxic contaminants with volatile organics being the most prevalent category, are present in groundwater within most of the study area. (See also W87-01669) (Lantz-PTT)
W87-01698

IDENTIFICATION AND REMOVAL OF HYDROCARBONS FROM UNCONSOLIDATED SEDIMENTS AFFECTED BY TIDAL FLUCTUATIONS,
Wright (R.E.) Associates, Middletown, PA.
K. V. Littlefield, N. E. Wehler, and R. W. Heard.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 316-322, 8 fig, 5 ref.

Descriptors: *Hydrocarbons, *Groundwater pollution, *Water pollution treatment, *Unconsolidated aquifers, *Sediments, *Tides, Accumulation, Water table, Geophysics, Geohydrology, Soil types, Pumps, Oil pollution, Oil recovery, Cleanup operations, Skimmers.

Multiple product losses occurred in a petroleum tank farm through its 80 year history. Accumulation of the product in the water table and subsequent migration resulted in seepage from the site into an adjacent creek. A thorough hydrogeological investigation was designed to identify variations in the subsurface that controlled migration of the hydrocarbons. Geologic logging of the soils, geophysical surveys and aquifer tests revealed the presence of abandoned stream channels, which acted as preferred conduits for the movement of the hydrocarbons. Interlayered fine- and coarse-grained sediments resulted in the formation of natural traps where oil preferentially accumulated. Three major 'pools' were located and an 8-inch recovery well was installed in each pool. Water table depression pumps placed in these wells created cones of depression that induced oil from the aquifer. Complications in the recovery method due to tidal fluctuations and changes in pumping level caused by mineral precipitation in the well and depression pumps were overcome by the use of an Auto-Skimmer to recover the floating hydrocarbons. This equipment automatically compensated for the changes in water level and product thickness and was used to successfully recover more than 24,000 gallons of product in the first 240 days of the operation. Additional application of the Auto-Skimmer in a monitor well adjacent to the creek without a water table depression pump resulted in additional product recovery. The recovery effort presently continues with noticeable decrease in oil seepage to the creek, oil thickness in the aquifer and oil recovery rate. (See also W87-01669) (Author's abstract)
W87-01706

HYDROGEOLOGIC SITE ASSESSMENT VS. REALITY AT A CHEMICAL PLANT,
Roux Associates, Inc., Halesite, NY.
For primary bibliographic entry see Field 5B.
W87-01710

ON-SITE CONTAINMENT OF PCB-CONTAMINATED SOILS AT AEROVOX INC., NEW BEDFORD, MASSACHUSETTS,
For primary bibliographic entry see Field 5B.
W87-01714

BIOLOGICAL MONITORING OF MARINE POLLUTANTS.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 5C.
W87-01717

MERCURY IN MUSSELS OF BELLINGHAM BAY, WASHINGTON (U.S.A.): THE OCCURRENCE OF MERCURY-BINDING PROTEINS,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5B.
W87-01732

EFFECTS OF MUNICIPAL WASTEWATER ON FERTILIZATION, SURVIVAL, AND DEVELOPMENT OF THE SEA URCHIN, STRONGYLOCENTROTUS PURPURATUS,
Southern California Coastal Water Research Project Authority, Long Beach.
For primary bibliographic entry see Field 5C.
W87-01733

AVAILABILITY OF AUTOMATIC WATER QUALITY MONITORING FOR FINNISH WATERCOURSES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W87-01739

5B. Sources Of Pollution

CONSIDERATION OF GROUNDWATER POLLUTANT REACTIONS IN MATHEMATICAL MODELING,
Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
R. A. Ferrara.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 246-260, 6 fig, 6 ref.

Descriptors: *Groundwater pollution, *Mathematical models, *Chemical reactions, Path of pollutants, Environmental effects, Organic compounds, Groundwater movement, Model studies, Pleasantville, New Jersey.

Mathematical modeling and the relative importance of transport and reactions in determining the fate of toxic organic contaminants in groundwater systems, are the focus of this paper. Such pollutants exhibit characteristics significantly different from conventional pollutants in that the former (1) have slower reaction rates, (2) may present a significant environmental impact at small doses and therefore low concentrations, (3) may exist in pure or particulate as well as dissolved phases, and (4) have very large residence times. Reaction processes involving toxic organic chemicals normally result in the transformation of the parent compound to daughter compounds which may be more or less desirable than the original compound. The rates of the various reactions differ widely depending on the particular compound and the environ-

mental conditions under which the reaction takes place. Models which consider sorption, biodegradation, volatilization, and acid-base equilibria are discussed and applied via a case study in Pleasantville, New Jersey. The study indicates that simulations provide some guidance as to the range of values within which it is clearly necessary or clearly unnecessary to model transformation processes in addition to transport processes. The impact on a model's prediction of the migration of a contaminant plume can be substantial. Similarly, when such models are used to evaluate aquifer restoration techniques, the consideration of transformation terms can also be important. (See also W87-00832) (Lantz-PTT)
W87-00849

EPICHLOROHYDRIN IN SECONDARY CONTAINMENT SYSTEMS,
Carlisle SynTec Systems, PA.
W. E. Witherow.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 314-325, 8 fig, 35 ref.

Descriptors: *Epichlorohydrin, *Underground waste disposal, *Secondary wastewater, Groundwater pollution, Physical properties, Liners, Aromatic hydrocarbons, Oil pollution, Fort Lauderdale, Florida, Storage tanks.

This paper first defines the problem of leaking underground fuel tanks and the real and potential threats to groundwater in the U.S. Next, legislation describing how the EPA will regulate fuel tanks is presented. More importantly, several states have taken the regulatory lead on underground tanks. The legal and liability ramifications of Federal or state legislations and their effect on tank owners is briefly covered. Leak detection and spill containment and collection system options such as secondary containment systems are included as possible solutions to this serious and emerging problem. Finally, this paper specifically investigates a wide spectrum of physical properties especially aromatic hydrocarbon resistance, for an unsupported epichlorohydrin lining that is being used today in several secondary containment systems in the United States. Laboratory testing was performed in accordance with the latest American Society of Testing and Materials (ASTM) standard test methods. Some of the more important physical properties are tensile strength, elongation, modulus, % swell (by volume) and water vapor permeability. Short- and long-term immersion studies were conducted in crude oil and diesel fuel 2 at room and elevated temperatures. Also, comparative studies were performed to evaluate other materials such as thermoplastic chlorinated polyethylene (CPE) and Hypalon and polychloroprene or neoprene (CR) rubber in ASTM Oil 3, ASTM Fuel C and American and European gasohol at room and elevated temperatures. A case history about the first epichlorohydrin secondary containment system in Ft. Lauderdale, FL showing typical installation and advantages such as cost effectiveness, watertightness, low permeability and flexibility is presented. Results of the study indicate that the number of leaking tanks is increasing. An additional 350,000 tanks are expected to begin leaking within 5 years. The EPA reports that because of these leaks, gasoline may be one of the most common causes of groundwater pollution in many parts of the country. If no action is taken in the next decade, the author's predict that up to 75% of these old (bare steel) tanks may begin leaking. (See also W87-00832) (Lantz-PTT)
W87-00854

GENERAL GUIDELINES FOR MONITORING CONTAMINANTS IN RESERVOIRS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5G.
W87-00871

EVALUATION OF THE VALIDITY AND STATISTICAL VARIABILITY OF LITHIUM AND FLUORIDE DISTRIBUTION COEFFICIENT VALUES IN A COMPLEX GEOCHEMICAL SYSTEM,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2K.
W87-00874

ANAEROBIC MICROBIAL TRANSFORMATIONS IN SUBSURFACE ENVIRONMENTS – HIGHLIGHTS,
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
A. J. Francis.
DOE Research Highlights Report DOE/ER-0243, September 1985. 13 p, 6 fig, 5 tab, 3 ref. DOE Contract No. DE-AC02-76CH00016.

Descriptors: *Microbial degradation, *Fate of pollutants, *Anaerobic digestion, *Subsurface environment, Path of pollutants, Arsenic, Cadmium, Chromium, Mercury, Manganese, Nickel, Lead, Organic compounds, Heavy metals, Trace metals, Chemical precipitation.

The overall objective of this research is to evaluate the significance of anaerobic microbial processes involved in the transformation, fate, and transport of chemical substances such as As, Cd, Cr, Hg, Mn, Ni, and Pb, and selected organic compounds in the subsurface environments. In this study, the basic biogeochemical mechanisms involved in the microbial mobilization or immobilization of toxic metals under subsurface (anaerobic) environmental conditions, and the effects of selected organic compounds and their intermediates in the degradative pathways on anaerobic microbial activity and metal mobilization or immobilization were investigated. Initial laboratory and field studies indicate that under appropriate conditions, dissolution of trace metals (Cr, Fe, Mn, Ni and Zn) due to anaerobic microbial action in subsurface environments could be significant. Decrease in concentrations of soluble Ni and Zn in selected samples is presumably due to sulfate reduction and formation of insoluble metal sulfides. Based on the geochemical analyses of the association of trace metals with various mineral phases in coal cleaning waste and core samples from the field site, it appears that the predominant mechanism of dissolution of metals, under anaerobic conditions, is due to direct bacterial reduction of iron-and manganese-oxides and release of trace metals coprecipitated with oxides. Anaerobic microbial dissolution of trace metals may be from: (1) naturally occurring forms of minerals, (2) modified or altered forms due to energy related activities, or (3) trace metals coprecipitated with iron and manganese-oxides. (Lantz-PTT)
W87-00875

ANAEROBIC BIOGEOCHEMICAL PROCESSES IN THE SUBSURFACE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
J. -M. Bollag.
Scientific Results of an ISIS Seminar held at Pennsylvania State University, State College, Pennsylvania on May 13-15, 1985. DOE Report No. DOE/ER-0252. 41 p, 1 append.

Descriptors: *Biogeochemistry, *Path of pollutants, *Fate of pollutants, *Anaerobic digestion, *Anaerobic environment, *Subsurface environment, *Groundwater pollution, Information exchange, Soil environment, Aquifers, Contamination, Geohydrology.

The role of microbial processes in the biogeochemical transformation and mobilization of organic and organometallic contaminants in subsurface ecosystems was the main topic of this seminar. Participating were scientists from Universities and National Laboratories with expertise in environmental microbiology, microbial ecology, biochemistry, geochemistry, and hydrogeology, and who are active in research related to subsurface environments. Anaerobic microbial processes were emphasized during the seminar because information in this area is particularly sparse. However, most concerns and problems mentioned for anaerobic processes apply equally well to aerobic processes in the subsurface. The potential problems which may arise from aquifer contamination are far-reaching and of immerse practical importance. Efficiency in acquiring scientific information in this area is critical. The coordinated effort suggested here, has distinct advantages over the (more common) uncoordinated academic approach because the subsurface environment is extremely complex. Valid and relevant scientific information can efficiently be obtained by encouraging communication between the many seemingly distant disciplines involved. It is hoped that the collaboration of geochemists, microbiologists, hydrologists, computer scientists, etc. will be substantially advance the knowledge of subsurface biogeochemical process during the next five to ten years. (Lantz-PTT)
W87-00884

HYDROPHYSICAL INTERACTIONS OF ORGANIC CHEMICALS WITH GEOLOGICAL MATERIALS: REVIEW OF INTERACTIONS OF ORGANIC CHEMICALS IN THE SUBSURFACE WITH EMPHASIS ON CLAYS AND LOW PERMEABILITY SEDIMENTARY ROCKS.
Battelle Pacific Northwest Labs., Richland, WA.
DOE Research Highlights Report DOE/ER-0228, May 1985. 23 p, 43 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Hydrophysics, *Organic compounds, *Earth-water interfaces, *Clays, *Permeability, *Sedimentary rocks, Aquifers, Organic wastes.

Presented is a review of the current literature on hydrophysical interactions of organic solutes with sedimentary rocks of low permeability. The motivation behind this study was the premise that low permeability rocks may act as secondary (aquifer) barriers for the containment of hazardous organic wastes, thus preventing these wastes from contaminating the groundwater. However, this premise may be incorrect if organic wastes can affect the hydraulic conductivity of these rocks. The results of this literature search as well as conversations with other researchers in this and related areas indicate that very little work has been done concerning interactions of organics with consolidated subsurface materials. Available information on three related topics was summarized in this report: the effect of organic compounds on the hydrophysical properties of clays, case studies concerning the interactions of organic compounds with clays and sedimentary rocks, and the effect of shales on inorganic transport. These studies give an indication of some research areas that need to be explored with regard to the effect of organic compounds on the hydrophysical properties of sedimentary rocks; these research needs are briefly summarized. The questions raised need to be addressed before it is possible to make accurate predictions of organic transport in the subsurface environment. (Lantz-PTT)
W87-00885

THRESHOLDS FOR ACIDIFICATION: A FRAMEWORK FOR POLICY AND RESEARCH,
Environmental Defense Fund, New York.
M. Oppenheimer.
Available from the Environmental Defense Fund, 1616 P Street, NW, Washington, DC. 20036. April 1986. 13 p, 36 ref.

Descriptors: *Acid rain, *Research priorities, *Policy making, Surface water, Soil chemistry, Acid water, Watersheds, Scandinavia, United States, Lakes.

The mechanisms which underlie the acidification of lakes by atmospheric deposition are described. The time dependent response of soils and surface waters to deposited sulfate is analyzed in order to develop a framework for identifying deposition thresholds for acidification. Observations of the relation of deposition values to acidification status indicate that lakes are acidified in sensitive watersheds receiving about 12-13 kg SO4/ha/yr wet deposition in eastern North America, and 15 kg SO4/ha/yr total deposition in Scandinavia. How-

ever, since watershed properties are time-dependent, these values are upper limits on the long term threshold for acidification since they will decrease with time. A theoretical analysis suggests that over several decades, acidification thresholds may fall as low as 10 kg SO4/ha/yr total deposition in eastern North America and 5 kg SO4/ha/yr in Scandinavia for acidification of the most sensitive lakes. The Scandinavia values probably pertain to the Western United States as well. (Lantz-PTT)
W87-00890

HYDROCHEMICAL PROCESSES IN THE REGIONAL GROUND WATER DISCHARGE ZONES OF THE MURRAY BASIN, SOUTH-EASTERN AUSTRALIA,
Victoria Dept. of Minerals and Energy, Melbourne (Australia).
For primary bibliographic entry see Field 2F.
W87-00895

SAMPLING AND ANALYSIS OF SUBSURFACE WATER,
R. W. Hull, Y. K. Kharaka, A. S. Maest, and T. L. Fries.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 117-126, 3 fig, 2 tab, 62 ref.

Descriptors: *Water sampling, *Water analysis, *Groundwater quality, *Geochemistry, Aquifers, Sample preservation, *Infiltration, Dissolved solids, Acidification, Aluminum, Mercuric chloride, Sodium azide, Potassium permangenate.

Geochemical studies are generally more comprehensive and detailed than those required to monitor a given water supply or contamination site. These studies, which generally include the use of geochemical models, require detailed knowledge of the hydrologic and mineralogic properties of the aquifer, as well as the spatial and temporal compositions of its water and gases. This paper summarizes the methods used for the collection, preservation and chemical analysis of subsurface water. Detailed procedures for collection include equipment and precautions necessary to ensure that the sample is 'representative' of the water in a specified part of the aquifer. Field procedures for sample preservation include filtration (0.1 micrometers for dissolved organics and other dissolved species), acidification, dilution for silica (in hydrothermal water), extraction of aluminum (labile, monomeric) addition of mercuric chloride or sodium azide, and potassium permanganate to preserve dissolved organics and mercury respectively, and precipitation of carbonate species for carbon isotopes and total dissolved carbonate analyses. Properties determined in the field include temperature, sulfide, pH, Eh, ammonia, alkalinity and conductivity. Analysis of cations are performed by atomic absorption and flame emission spectrophotometry. Graphite-furnace AA with zeeman-background correction is used for the determination of most metals. However, inductively coupled plasma atomic emission spectrometry (ICP-AES) is becoming the selected method for the determination of many cations and metals. An increasing number of anionic species, including sulfate, bromide and iodide are being determined by ion chromatographic techniques. Dissolved organics are determined by gas chromatography and other instrumentation, such as mass spectrometry. (See also W87-00892) (Author's abstract)
W87-00899

PERFORMANCE EVALUATION OF RCRA INDICATOR PARAMETERS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
R. H. Plumb, and C. k. Fitzsimmons.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 129-137, 5 fig, 3 tab, 7 ref.

Descriptors: *Hazardous waste management, *Performance evaluation, *Legislation, *Groundwater quality, *Water analysis, Hazardous wastes, Disposal sites, Hydrogen ion concentration, Specific conductivity, Organic carbon, Organic halogen, Chemical analysis, Graphical analysis.

Hazardous waste management facilities that have been classified as Interim Status are required to implement a groundwater monitoring program utilizing four specified indicator parameters to determine whether the site is leaking hazardous constituents. This paper describes a graphical method that was applied at 17 Superfund sites and 14 RCRA sites to evaluate the performance of pH, specific conductance, total organic carbon (TOC) and total organic halogen (TOX) as indicators of changing groundwater conditions. The method consists of tabulating relative downgradient concentration changes for all available and appropriate analytes as a function of observed indicator parameter changes. The resultant two-dimensional data array is compared to a response pattern that would be expected if the indicators are functioning effectively. The initial results of this approach, using a concentration differential of 10% as a measure of change, suggest that simultaneous pH-analyte changes follow a predictive pattern only 43% of the time. Corresponding figures for specific conductance, TOC, and TOX are 43%, 17% and 35%, respectively. The frequency of false negatives, non-detected analyte increases, ranged from 12% for pH, to 8% for specific conductance, to 4% for TOC and 1% for TOX. Deviations from ideal response patterns were observed for major cations (calcium, magnesium, sodium), major anions (chloride, sulfate, nitrate), trace metals (iron, manganese, barium, lead, zinc) and organic compounds (cyanide, phenol). These results should be considered tentative because of several identified limitations that affect the quality and completeness of the available data. (See also W87-00892) (Author's abstract)
W87-00900

GEOCHEMISTRY AND ALTERATION PROCESSES OF URANIUM TAILINGS IN GROUND WATER, GRANTS MINERAL BELT, NEW MEXICO,
New Mexico Environmental Improvement Agency, Santa Fe.
P. Longmire.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 190-199, 7 fig, 4 tab, 24 ref.

Descriptors: *Path of pollutants, *Radioactive wastes, *Uranium radioisotopes, *Geochemistry, *Uranium, *Mine wastes, *Groundwater pollution, *New Mexico, Aquifers, Hydrogen ion concentration, Alkalinity, Sulfates, Pore fluid, Groundwater quality, Chemical analysis.

Uranium tailings consist of unrecovered ore and gangue and contain large amounts of sulfate salts. Pore fluid is characterized by a low pH (2), high Eh (+0.70V), a moderate ionic strength (0.37M), and contains high activities of metal sulfate and metal chloride complexes. Upon initial burial, pore fluid within the backfill is oversaturated with respect to gypsum, goethite, hematite, barite, quartz, gibbsite and kaolinite in oxidizing groundwater. Gypsum is the most abundant salt. Enrichment of metals by claysized material has been shown for uranium, thorium, selenium, chromium, vanadium, cobalt, manganese and molybdenum. Further alteration processes occur as pore fluid equilibrates with native (reducing) groundwater: (1) Gypsum dissolves, releasing calcium, sulfate and sorbed ions; (2) Calcite may partially replace gypsums; (3) Detrital and authigenic phases, including kaolinite, albite, microcline and montmorillonite, may undergo incongruent surface-controlled dissolution followed by limited release of radium, strontium, sodium, potassium, aluminum, silica and sorbed ions; and (4) Dissolved uranium is stable as uranyl carbonato and hydroxo complexes that are mobile in groundwater. Short temporal degradation of groundwater quality may occur in areas adjacent to backfill results, due to gypsum and pyrite dissolution. (See also W87-00892) (Lantz-PTT)
W87-00903

INTERACTIONS OF ACIDIC SOLUTIONS WITH SEDIMENTS: A CASE STUDY,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W87-00905

REVIEW OF MICROBIAL INFLUENCES ON THE EVOLUTION OF GROUND WATER CHEMISTRY WITH SOME PRACTICAL APPLICATIONS FROM COAL MINE RECLAMATION STUDIES IN ALBERTA,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 5C.
W87-00911

SULFUR CYCLE IN WESTERN NORTH DAKOTA COAL MINES,
Geological Survey, Bismarck, ND. Water Resources Div.
R. L. Houghton, R. D. Koob, and G. H. Groenewold.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 306-313, 8 fig, 26 ref.

Descriptors: *Path of pollutants, *Sulfur, *Coal mines, *North Dakota, Geochemistry, Oxidation, Sulfates, Sulfur bacteria, Microbial degradation, Groundwater.

The distribution and sulfur-isotopic composition of sulfur species in groundwater and sedimentary rocks and soils associated with lignite strip mines in western and central North Dakota indicate microbes may play an important role in sulfur oxidation and sulfate reduction. Oxidation of microcrystalline and framboidal iron-sulfide minerals during mining occurs rapidly in the presence of oxygen and is mediated by sulfur-oxidizing bacteria. However, macrocrystalline pyrite is essentially inert to oxygen and microbial activity for decades. Sulfate in groundwater is derived from the repeated dissolution, precipitation and redissolution of sulfate salts by infiltrating water. Microbially accelerated sulfide oxidation in mine areas helps increase groundwater sulfate concentrations above equilibrium conditions. However, microbially mediated sulfate reduction decreases groundwater sulfate concentrations downgradient of mine sites. (See also W87-00892) (Author's abstract)
W87-00912

TRANSPORT MODELS FOR INLAND AND COASTAL WATERS.
International Association for Hydraulic Research, Delft (Netherlands).
Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. Edited by Hugo B. Fischer. 542 p.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Estuaries, *Prediction, *Lakes, Accuracy, Mathematical models.

A symposium considered whether pollutant transport models are truly predictive of natural events. A framework for evaluating predictive ability is set forth in Chapter 1. Subsequent papers concern modeling of pollutant dispersion and/or salinity in estuaries, rivers, lakes, reservoirs, lagoons, coastal waters. Predictive ability does not appear to depend strongly on the choice of numerical algorithm; its limits are related to gaps in physical understanding and ability to model detail. No general statements can be made concerning predictability of models. No adequate numerical models exist for stratified estuaries. In spite of recent computer advances, numerical models must make substantial concessions to computer limitations. (See also W87-00923 thru W87-00934) (Cassar-PTT)
W87-00922

MATHEMATICAL MODELING OF FLOWS AND TRANSPORT OF CONSERVATIVE SUB-

STANCES: REQUIREMENTS FOR PREDICTIVE ABILITY,
Waterloopkundig Lab. te Delft (Netherlands).
G. Abraham, A. G. van Os, and G. K. Verboom.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 1-38, 7 fig, 1 tab, 56 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Solute transport, *Prediction, Accuracy, Mathematical models, Turbulent flow, Eddy diffusion, Boundary conditions.

Mathematical models of flows and transport in natural receiving waters have several main requirements for predictive ability as well as factors leading to limited predictive ability. The requirements for predictive ability include having a verified mathematical model and a statement on the model's accuracy and range of applicability at the end of feedback loop 3. This statement on the range of applicability must indicate whether the accuracy of the verified mathematical model may be expected to be retained when extrapolating outside the range of experimental conditions covered in the calibration and verification of the model. Predictive ability is limited whenever research underlying the mathematical model is not completed. In addition, limited predictive ability may be caused by uncertainty with respect to open boundary conditions or an excessively coarse grid size for the geometric representation of the problem area. (See also W87-00922) (Cassar-PTT)
W87-00923

PREDICTIVE ABILITY OF ONE-DIMENSIONAL ESTUARY MODELS,
Hydraulics Research Station, Wallingford (England).
N. V. M. Odd.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 39-62, 11 fig, 17 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Estuaries, *Solute transport, *Prediction, Accuracy, Mathematical models, Salinity, Tidal effects, Rivers, Sediment transport.

The main factors affecting the accuracy and predictive ability of one-dimensional estuary models are: (a) the schematic representation of the geometry of the tidal channel system; (b) the representation of frictional dissipation in the case of estuaries with a high dissipation factor; (c) the empirical representation of the physical processes causing longitudinal dispersion of solutes; (d) the accuracy of the numerical treatment of the advective terms especially in the case of steep longitudinal gradients; (e) the methods of proving and using such models especially the formulation of comparative predictive tests; and (f) the method of analyzing the results, which should lead to a good understanding of the causes of any changes predicted by the model. (See also W87-00922) (Author abstract)
W87-00924

PREDICTION OF FLOW AND POLLUTANT SPREADING IN RIVERS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
W. Rodi, R. N. Pavlovic, and S. K. Srivatsa.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 63-111, 22 fig, 2 tab, 29 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Rivers, *Solute transport, *Prediction, Accuracy, Mathematical models, Flow, Wastewater pollution, Mixing, Turbulent flow, Neckar River, Stuttgart, Germany, Rhine River, Karlsruhe Power Station, Cooling water, Thermal pollution.

A mathematical model can resolve the details of the near field of a wastewater discharge and can be applied to longer river stretches without excessive computational cost. It uses the model-chain concept in which the river is divided into characteristic regions and the simplest possible model component used for each region. A refined turbulence model resolves the details of the near field where a complex interaction takes place between discharge-jet-generated and bed-generated turbulence. In the far-field, except near banks, the model leads to the same diffusivity relation as used in conventional diffusion models. Two examples are given: wastewater discharge into the Neckar River at Stuttgart, Germany, and cooling water discharge into the Rhine River at Karlsruhe. When the discharge is located near the surface, behavior is predicted well. For submerged discharges three-dimensional effects are so strong that the field near the jet exit is difficult to simulate with a two-dimensional model. This situation points out the difficulties of two-dimensional models and the advantages of three-dimensional models. (See also W87-00925) (Cassar-PTT)
W87-00925

MODELING OF LAGOONS: THE EXPERIENCE OF VENICE,
Padua Univ. (Italy). Ist. di Idraulica.
G. DiSilvio, and G. Fiorillo.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 112-139, 17 fig, 17 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Estuaries, *Lagoons, *Solute transport, *Prediction, Accuracy, Estuaries, Rivers, Prediction, Mathematical models, Flow, Wastewater pollution, Mixing, Venice, Italy, Floods, Tracers, Dye releases, Hydrodynamics, Water currents, Tides.

One- and two-dimensional models were used to simulate water circulation in the Venice, Italy, lagoon. Neither model could duplicate the detailed prototype's distribution of tracer concentration. However, both have useful information on the overall dispersion process. Both models are reasonably able to simulate water exchanges. Although the instantaneous velocity field reproduced by the two-dimensional model is undoubtedly closer to the real one, the tracer experiment results are perhaps better reproduced by the one-dimensional model. With respect to transport along the deepest channels, the one-dimensional model tends to exaggerate it and the two-dimensional model tends to underestimate it. The two-dimensional model is more appropriate for simulating the current pattern in a specified tidal or wind condition which requires a short simulation. If a longer simulation is needed, for example, studying the continuous output of several different wastes over a week's period, the opposite is true. For a two-week simulation the computational costs are less than a thousand dollars for the one-dimensional model vs. tens of thousands of dollars for the two-dimensional model. (See also W87-00922) (Cassar-PTT)
W87-00926

TECHNIQUES FOR FIELD VERIFICATION OF MODELS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. W. Pritchard.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 140-171, 22 fig, 17 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Estuaries, *Solute transport, Prediction, Accuracy, Mathematical models, Salinity, Tidal effects, Rivers, Hydraulic models, Numerical models, Chesapeake and Delaware Canal, Thermal pollution, Cooling water, Tracers, Water quality.

Techniques are described for measurement and analysis of field data to be used in verification of the flow and of the physical transport of dissolved and finely divided materials in estuaries and tidal waterways. Models are of three types: hydraulic models (three-dimensional and used in a pseudo steady-state), numerical models of the hydrodynamic and kinematic processes which control the rise and fall of the tide, oscillatory tidal flow and the density-driven and wind-driven non-tidal flows, and water quality models of the distribution of conservative, water-borne constituents of the water bodies. Techniques for measurement include water surface elevation data from tidal gages, current speed and direction, salinity, and water-borne tracer dyes. Examples are a transient state one-dimensional dynamic model of the Chesapeake and Delaware Canal, transient state, one-dimensional water quality model of the Chesapeake and Delaware Canal, and transient state two-dimensional thermal plume model at Vienna, Maryland. (See also W87-00922) (Cassar-PTT)
W87-00927

SPECTRA PRESERVATION CAPABILITIES OF GREAT LAKES TRANSPORT MODELS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. W. Bedford.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 172-221, 24 fig, 3 tab, 81 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Lakes, *Solute transport, *Prediction, Accuracy, Mathematical models, Great Lakes, Turbulent flow, Water circulation, Water currents, Spectral distribution, Eddies.

Three conclusions were made in a study of three-dimensional lake models. (1) Special steps, aside from mesh refinement, are necessary to prepare a model for economical, high Reynolds Number, spectrally correct turbulence predictions. Filtration is necessary, otherwise energy is not cascaded properly. The time step must be placed in the frequency spectra inertial subrange to prevent the inadvertent resolution of hydrodynamic activity that model assumptions prohibit. (2) The spectral behavior of lake models indicates that they propagate energy as two-dimensional models and therefore are not three-dimensional. The general spectral shapes are properly portrayed and contained between the proper maximum and minimum scales. (3) If model time steps resolve physics with length scales the size of the depth, the hydrostatic assumption must be abandoned as model results are erroneous. None of the commonly applied remedies for controlling stability (eddy viscosity, upwind or down-wind differencing) correct the inability of traditional models to adequately propagate energy. (See also W87-00922) (Cassar-PTT)
W87-00928

NUMERICAL MODELING OF FREE-SURFACE FLOWS THAT ARE TWO-DIMENSIONAL IN PLAN,
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
M. B. Abbott.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 222-283, 26 fig, 20 ref.

Descriptors: *Fate of pollutants, *Model studies, *Estuaries, *Solute transport, *Prediction, *Surface flow, Mathematical models, Tidal effects, Rivers, North Sea, Oil spills, Ho Bay, Arhus Bay, Vendysselvaeket, Denmark, Misarata, Libya, Water currents, Water circulation.

Applications of free-surface flow models are presented for several sites on the coast of Denmark (North Sea, which predicts storm surge levels and is used for oil spill study; Ho Bay; Arhus Bay; and the Vendysselvaerket power station at Aalborg) and at Misurata, Libya. A discussion of sub-grid scale modeling is presented. (See also W87-00922) (Cassar-PTT)

W87-00929

MODELING OF HEATED WATER DISCHARGES ON THE FRENCH COAST OF THE ENGLISH CHANNEL,
Laboratoire National d'Hydraulique, Chatou (France).
F. Boulet.
IN: Transport Models for Inland and Coastal Waters, Academic Press, New York. 1981. Proceedings of a Symposium on Predictive Ability, Berkeley, California, August 18-20, 1980. p 362-407, 25 fig, 15 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Prediction, Accuracy, Mathematical models, Thermal pollution, Cooling water, France, Water quality, Heated water, Temperature effects, Powerplants, Tides, Water currents, Shallow water.

The modeling patterns used to study the dilution of effluents from powerplants planned by Electricite de France on the French coast of the English Channel are described. Difficulties are experienced with the actual geometry of the area of the effluent discharge. At the time of publication no plants existed to verify the model results. However, for the near field, the PANACH code for dilution in a cross current yields results consistent with observed data. For the far field the most important phenomena is tidal current advection; these results also agree with in situ results. Information on the residual current field is not available; however, this is not believed vital for short-lived pollutants such as heat. (See also W87-00922) (Cassar-PTT)
W87-00931

YEAR 4, RUNOFF WATER QUALITY, AUGUST 1980-AUGUST 1981,
Washington Univ., Seattle. Dept. of Civil Engineering.
B. W. Mar, J. F. Ferguson, D. E. Spyridakis, E. B. Welsh, and R. R. Horner.
Available from the National Technical Information Service, Springfield, VA.22161, asPB83-171504, Price codes: A03 in paper copy, A01 in microfiche. Interim Report No. WA-RD-39.13, August 1981. 21 p, 1 fig, 9 tab, 15 ref. Contract No. Y-1804.

Descriptors: *Water pollution sources, *Water pollution effects, *Highway effects, *Runoff, Environmental effects, Ecosystems, Aquatic animals, Zooplankton, Algae, Fish, Toxicity, Storm water, Model studies, Washington, Heavy metals, Metals, Bioassay, Water quality, Suspended solids.

This interim report summarizes the results of Reports 10, 11, and 12 in a series of studies of highway runoff water quality in Washington state. Report No. 10 - Mobility of metals was low in well-vegetated surfaces adjacent to highways. For example, a 40-ft grassy drainage channel effectively captured 80% of the original lead. Mud or paved channels, however, demonstrated little or no ability to remove metals from runoff. Metal release studies suggested that acid precipitation could release metals bound in soil of low buffering capacity. Report No. 11 - Bioassays on the impact of storm water runoff from freeways showed that algae and zooplankton were adversely affected by the soluble fraction of the runoff, while suspended solids caused high mortalities of rainbow trout fry. Indications were that results were influenced by toxicity to microbial populations. Report No. 12 - A predictive model was developed based on monitoring results of highway storm runoff. A high correlation was demonstrated between total suspended solids and COD, metals and nutrients. The major factor controlling pollution loads was the number of vehicles passing during each storm, not those preceding storms. (Cassar-PTT)
W87-00935

FECAL INDICATOR BACTERIA AT FRESHWATER RAINBOW TROUT (SALMO GAIRDNERD) FARMS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
M. Niemi.
Water Research Institute Publication 64, 1985. 49 p, 12 fig, 24 tab, 11 ref, 3 append.

Descriptors: *Water pollution sources, *Fish farming, *Bacteria, Farming Aquaculture, Streptococcus, Coliforms, Rainbow trout, Trout, Escherichia coli, Aeromonas hydrophila, Citrobacter, Water quality, Fish ponds.

The occurrence of fecal indicator bacteria, such as fecal streptococci, total coliforms and thermotolerant coliforms, was measured at rainbow trout farms during the growing season. Multiplication of presumptive fecal streptococci and total coliforms at the farms was considerable. However, confirmation with bile esculin azide agar at 44 degrees C and tolerance tests revealed that the increase of presumptive fecal streptococci was due to nonfecal strains. Only a minority of total coliform bacteria were Escherichia coli, whereas the vast majority of thermotolerant coliforms were E. coli. These bacteria only occasionally increased at fish farms. These results were interpreted as an indication of fecal contamination of runoff waters at the farm. The contamination was probably due to bird droppings. Coliform bacteria were identified using the APE 20 E system. Citrobacter, Aeromonas hydrophila and E. coli were the major taxa. However, many of the isolates remained unidentified and the reliability of identification to Citrobacter freundii was questionable. Numerical taxonomy was therefore applied to this material. (Author's abstract)
W87-00936

EFFECTS OF SEATTLE AREA HIGHWAY STORMWATER RUNOFF ON AQUATIC BIOTA,
Washington Univ., Seattle. Dept. of Civil Engineering.
G. J. Portele, B. W. Mar, R. R. Horner, and E. B. Welsh.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-170761, Price codes: A04 in paper copy, A01 in microfiche. Interim Report No. WA-RD-39.11, January 1982. 45 p, 11 tab, 61 ref. Contract No. Y-1804.

Descriptors: *Water pollution sources, *Water pollution effects, *Highway effects, *Runoff, Environmental effects, Ecosystems, Aquatic animals, Zooplankton, Algae, Fish, Toxicity, Storm water, Washington, Bioassay, Water quality, Suspended solids, Trout, Rainbow trout, Biochemical oxygen demand.

The impacts of stormwater runoff from Washington State freeways on aquatic ecosystems were investigated through a series of bioassays utilizing algae, zooplankton and fish. Algae and zooplankton were adversely affected by the soluble fraction of the runoff, while suspended solids caused high mortalities of rainbow trout fry. In addition BOD values similar to those reported in the storm water literature were measured; however, there were indications that results were influenced by toxicity to microbial populations. (Author's abstract)
W87-00937

HIGHWAY RUNOFF IN WASHINGTON STATE: MODEL VALIDATION AND STATISTICAL ANALYSIS,
Washington Univ., Seattle. Dept. of Civil Engineering.
T. W. D. Chui, B. W. Mar, and R. R. Horner.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-171520, Price codes: A03 in paper copy, A01 in microfiche. Interim Report No. WA-RD-39.12, November 1981. 43 p, 8 fig, 13 tab, 24 ref. Contract No. Y-1804.

Descriptors: *Water pollution sources, *Water pollution effects, *Highway effects, *Runoff, Environmental effects, Storm water, Model studies, Washington, Water quality, Suspended solids, Asplund model.

Statewide sampling of highway runoff continued through 1980-81, and the resulting data has been aggregated with that from previous years to further investigate pollutant loadings. Results have validated the solids loading model previously proposed by Asplund (1980) for western Washington highways and tentatively extended the model to eastern Washington. Loadings of other pollutants can be predicted from total suspended solids loading using ratios derived from the data. These ratios may be taken as constants at any Washington State location for some pollutants or as linear functions of traffic for other contaminants. Comparison of runoff from a sulfur-extended asphalt pavement with runoff elsewhere indicates higher sulfate loads in the former case. A limited sampling program along an uncurbed highway section observed higher pollutant concentrations from these sections relative to curbed areas. Sampling of solids adhering to the undercarriage of automobiles produced widely varying results but suggested that vehicles traveling on rural or unpaved roads accumulate significant amounts of solids that can be released on highways. The final year of field sampling will concentrate on improving the loading models, especially for eastern Washington application, and continuing the sulfur-extended asphalt study with a functional control site experiencing the same conditions. (Author's abstract)
W87-00938

GUIDE FOR WATER QUALITY IMPACT ASSESSMENT OF HIGHWAY OPERATIONS AND MAINTENANCE,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. R. Horner, and B. W. Mar.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-170043, Price codes: A04 in paper copy, A01 in microfiche. Interim Report No. WA-RD-39.14, September 1982. 81 p, 9 fig, 7 tab, 48 ref, 4 append. Contract No. Y-1804.

Descriptors: *Water pollution sources, *Water pollution effects, *Highway effects, *Runoff, Environmental effects, Model studies, Storm water, Washington, Water quality.

Stepwise procedures are presented for assessing storm water runoff impacts on receiving waters resulting from highway operations and maintenance. The methods were developed from monitoring data collected in Washington state. The procedure has three levels. Level I is a rapid screening method for identifying cases having a low probability of extensive impacts. Level III is a detailed evaluation having a low probability of extensive impacts. Level III is a detailed evaluation focusing on impact mitigation. Within each level the analysis is concerned with runoff quantity, pollutant concentrations, and cumulative contaminant loadings. Highway runoff pollutant loadings are estimated using a model developed during the research and compared to existing receiving water loadings. Graphs establish the probability of exceeding pollutant concentration criteria in any storm. This guide is also useful in assessing water quality impacts of sanding, deicing, pesticide applications, woodwaste fill leachate, and accidental spills, as well as considerations where highway runoff affects groundwater. (Cassar-PTT)
W87-00939

JOINT REPORT OF THE SPECIAL ENVOYS ON ACID RAIN,
For primary bibliographic entry see Field 5C.
W87-00940

PLAN TO EVALUATE ACID-DEPOSITION ISSUES IN THE STATE OF TEXAS, VOLUME I,
Espey, Huston and Associates, Inc., Austin, TX.
For primary bibliographic entry see Field 5C.
W87-00941

STUDY OF THE RELATIONSHIP BETWEEN WATER QUALITY AND SEDIMENT TRANSPORT: A GUIDE FOR THE COLLECTION AND INTERPRETATION OF SEDIMENT QUALITY DATA,

For primary bibliographic entry see Field 2J.
W87-00948

LINKED HYDRODYNAMIC AND BIOGEOCHEMICAL MODELS OF WATER QUALITY IN SHALLOW LAKES,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
P. Shanahan, and D. R. F. Harleman.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-169110, Price codes: A15 in paper copy, A01 in microfiche. Report Number 268, March 1982. 279 p, 68 fig, 9 tab, 134 ref, 5 append. Grant NSF CEE-7906125.

Descriptors: *Geochemistry, *Lakes, *Water quality, *Model studies, Lake Balaton, Hungary, Phosphorus, Shallow lakes, Hydrodynamics, Finite difference methods, Computer programs, Mathematical models, Water quality management.

Approaches to lake water quality modeling are examined and the formulation of water quality transport as the link between hydrodynamics and biogeochemical reaction is emphasized. State-of-the-art modeling approaches for a biogeochemical reaction component, a lake hydrodynamics component, and a water quality transport component are reviewed and a synopsis of phosphorus dynamics in shallow lakes is given. A computer program incorporating a multiple box model and an alternative one-dimensional finite difference model is developed and applied to Lake Balaton in Hungary. The results are contrasted with those produced by a four-box model of the lake. The finite difference model is found to lead to a predicted behavior more similar to that observed in field data collected from Lake Balaton. Experimentation with the models is conducted to examine the behavior of the lake and the dominant factors leading to that behavior. (Author's abstract)
W87-00951

INFLUENCE OF LEACH RATE AND OTHER PARAMETERS ON GROUNDWATER MIGRATION,
Dames and Moore, White Plains, NY.
O. I. Oztunali, C. J. Pitt, and J. P. Furfaro.
Available from the National Technical Information Service, Springfield, VA. 22161, as NUREG/CR-3130, Price codes: A17 in paper copy, A01 in microfiche. February 1983. 293 p, 6 fig, 30 tab, 8 ref, 4 append.

Descriptors: *Radioactive waste disposal, *Path of pollutants, *Leaching, *Leachates, *Groundwater pollution, *Water pollution sources, Fate of pollutants, Waste disposal, *Radioactive wastes, Cement, Polymers, Resins, Sludge.

A sensitivity analysis was performed in which the leaching characteristics of selected low-level radioactive waste streams are varied, and the resulting potential groundwater impacts calculated, as a function of alternative disposal site environments and alternative facility designs and operating practices. The analysis also assessed whether a leaching standard for solidified waste streams is needed to ensure safe low-level waste disposal. In the analysis, the leach rate of particular waste streams suitable for solidification (LWR concentrated liquids, Class B and C LWR ion-exchange resins and filter sludge) was varied while the leach rate of other waste streams unsuitable for solidification was held constant. The results indicate that measures which reduce percolation into disposal cells and reduce contact of waste by water are less expensive and more effective in reducing groundwater impacts than large reductions in the leach rates of the waste streams suitable for solidification. Thus, a leach criteria which can be met by existing binders such as cement, bitumen, vinyl ester styrene, or synthetic polymers would probably be acceptable provided that the solidified product is structurally stable. The analysis also indicates that the presence of small quantities of free standing liquids within some of the waste containers would probably not result in significant additional groundwater impacts. (Author's abstract)
W87-00954

PROCEEDINGS OF THE WORKSHOP ON AGRICHEMICALS AND ESTUARINE PRODUCTIVITY.
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Marine Pollution Assessment.
For primary bibliographic entry see Field 2L.
W87-00957

DEFINITION OF AN ESTUARY,
Chesapeake Research Consortium, Inc., Annapolis, MD.
For primary bibliographic entry see Field 2L.
W87-00958

SCIENTIFIC LESSONS TAUGHT BY KEPONE,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W87-00960

FERTILIZER AND PESTICIDE MOVEMENT IN SURFACE WATER,
North Carolina State Univ. at Raleigh.
J. W. Gilliam, R. W. Skaggs, and T. J. Sheets.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 117-137, 1 fig, 7 tab, 15 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Estuaries, *Fertilizers, *Pesticides, Agricultural watersheds, North Carolina, Runoff, Organic matter, Phosphorus, Nitrogen, Sediments, Turbidity, Water quality, Alachlor, Surface water, Drainage.

A three-year study was conducted to determine the effects of agricultural drainage and development on hydrology and runoff water quality on high organic soils in the North Carolina tidewater region. Peak runoff rates occurred earlier and were 3 to 4 times higher on developed than on similar undeveloped lands. Runoff rate differences between developed and undeveloped land were smaller during large runoff events. In general, development caused a decrease in evapotranspiration and a consequent small increase in annual outflows. There was only a small increase in inorganic nitrogen in drainage water as a result of agricultural development. Development of the high organic mineral soil had a very small effect on phosphorus losses. However, both the developed shallow and deep organics lost considerably more phosphorus to drainage waters than corresponding undeveloped sites. Agricultural development resulted in a small increase in sediment load of drainage waters, and turbidity also increased, particularly during the development phase. Changes in pH and Ca, Mg, K, Na, and Cl concentrations had no apparent effect on water quality. Alachlor concentrations in drainage ditch water varied greatly among sites and years. Movement in surface runoff did not appear to be a major route of water contamination. (See also W87-00957) (Author's abstract)
W87-00964

QUALITY OF IRRIGATION RETURN FLOW FROM FLOODED RICE PADDIES,
Texas Agricultural Experiment Station, College Station.
K. W. Brown.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 139-175, 13 fig, 15 tab, 6 ref.

Descriptors: *Path of pollutants, *Estuaries, *Return flow, *Pesticides, *Rice, Irrigation-return flow, Water quality, Nitrates, Phosphates, Potassium, Fertilizers, Propanil, Molinate, Carbofuran, Carbaryl, Insecticides, Water pollution effects, Agricultural chemicals.

The quantity and quality of irrigation return flow from flooded rice culture was studied for three years. Selected pesticides and fertilizers were applied at recommended and excessive rates. Concentrations of nitrate, phosphate, and potassium in the return flow were within drinking water standards. Small amounts of fertilizers were lost in the return flow when applied before flood. The salt load of the return flow was similar to that of the irrigation water. Electrical conductivity of the flood water increased for 5-10 days after fertilizer application. Excessive rates of pesticide application to paddy water produced concentrations greater than the 96-hour-median tolerance for catfish. The 96-hour-median tolerance levels of 3 of the 4 pesticides tested were lower for paddy water than for tap water. At recommended application rates, the concentrations of propanil exceeded 10% of the 96-hour-TLM for 24 hours after application; for carbofuran, 20 days; for carbaryl, 6 days; and for molinate, zero days. Water should not be released from the paddies until after the specified period following application. In some cases pesticide remaining on foliage was washed into flood water by rain, increasing the concentration in the return flow. Low concentrations of pesticide metabolites were found in the fields. (See also W87-00957) (Cassar-PTT)
W87-00965

EVALUATION OF PESTICIDE IMPACT ON THE ENVIRONMENT–SHORTCUT METHODS USEFUL FOR HAZARD ASSESSMENT,
Dow Chemical U.S.A., Midland, MI.
For primary bibliographic entry see Field 5C.
W87-00966

ASSESSMENT OF GROUND AND SURFACE WATER EFFECTS AROUND COAL AND MINERAL STORAGE AREAS,
Hittman Associates, Inc., Columbia, MD.
For primary bibliographic entry see Field 5C.
W87-00970

SUMMARY AND SYNTHESIS.
For primary bibliographic entry see Field 5C.
W87-00972

UNCERTAINTIES IN TRENDS IN ACID DEPOSITION: THE ROLE OF CLIMATIC FLUCTUATIONS,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 2B.
W87-00973

STREAMS AND LAKES,
McMaster Univ., Hamilton (Ontario).
J. R. Kramer, A. W. Andren, R. A. Smith, A. H. Johnson, and R. B. Alexander.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 231-299, 16 fig, 9 tab, 101 ref.

Descriptors: *Acid rain, *Streams, *Lakes, *Water pollution effects, *Data interpretation, Climate, Air pollution, Land use, Statistical analysis, Sulfates, Alkalinity, Hydrogen ion concentration.

Various attempts have been made to assess changes in the acidity of surface waters that may have occurred over the past 50 years. Many of the analyses account for such complicating factors as changes in analytical methods and land use practices. There are, however, several acknowledged problems in the interpretation of 'historical' lake water chemistry data. Perhaps the chief drawback is the lack of documentation of sampling and analytical procedures. Additional factors that must be considered in interpreting current and historical data include (1) climatology, since the hydrology of lakes and rivers may vary considerably from year to year in response to fluctuations in precipitation and climatic factors affecting evaporation, (2) regional patterns of emissions of acid precursors, since natural waters downwind of sources may be expected to exhibit greater changes in water quality than those situated upwind, (3) changes in land use, (4) the statistical validity of using data separated 20 to 40 years to examine trends, and (5) representativeness of data sets for various regions. The current study tries to over-

come some of the difficulties mentioned above by examining temporal and spatial variations in several water quality parameters that simultaneously give some information about the acidic status of lakes. The quality selected to provide both a determination of regional trends in lake and stream acidification and an illustration of a consistent methodologic approach. Examined first in this chapter, is the hypothesis that sulfate levels in lakes and wet precipitation in the northeastern United States and eastern Canada are correlated. Next sulfate driven changes in stream water chemistry, using data from the U.S. Geological Survey Bench-Mark Network, is addressed. Finally, pH and alkalinity data of lakes taken at discrete time intervals, i.e., from the 1920s and 1930s to the 1970s and 1980s, are compared. (Lantz-PTT)
W87-00975

CHARACTERISTICS OF BENCH-MARK STREAMS.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 445-470, 3 tab, 23 ref.

Descriptors: *Bench-Mark streams, *Sulfates, *Acid rain, *Data collections, Watersheds, Streams, Alkalinity, Acidity, National Acid Deposition Program, NADP, Air pollution.

Given here are the locations of U.S. Geological Survey Benchmark streams used to monitor sulfate output from these watersheds. This value was estimated as the product of discharge-weighted mean sulfate concentrations and mean basin runoff for the 2-yr period from 1980-1981. Sulfate deposition at each site was estimated by linear interpolation of wet-only sulfate depositioin data from the National Acid Deposition Program (NADP) for 1980 and 1981. Also shown are 16 benchmark streams with alkalinities lower than 500 microequivalents/L. (See also W87-00971) (Lantz-PTT)
W87-00977

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOME LAKES IN NORTH AMERICA FOR WHICH SEDIMENT-DIATOM DATA EXIST.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 482-506, 1 fig, 5 tab, 31 ref.

Descriptors: *Lakes, *Physicochemical properties, *Sediments, Diatoms, Lake morphology, Alkalinity, Conductivity, Turbidity, Phosphorus, Chlorophyll a, Calcium, Magnesium, Sodium, Phosphorus, Sulfates, Nitrates, Chlorine, Aluminum, Hydrogen ion concentration, Acid rain, United States, Canada.

Tables are presented which give the following data on 27 lakes in the northeastern United States and southeastern Canada: (1) lake location and morphometric data; (2) surface water chemistry (alkalinity, conductivity, turbidity, total phosphorus, chlorophyll a level); (3) presence of calcium, magnesium, sodium, potassium, sulfate, nitrate and chloride ions; (4) total aluminum, (5) dating and diatom data; and, (6) a summary of diatom-inferred pH changes. (See also W87-00971) (Lantz-PTT)
W87-00978

ORGANIC MATTER MINERALIZATION WITH REDUCTION OF FERRIC IRON IN ANAEROBIC SEDIMENTS,
Geological Survey, Reston, VA. Water Resources Div.
D. R. Lovely, and E. J. P. Phillips.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 4, p 683-689, April 1986. 5 fig, 3 tab, 15 ref.

Descriptors: *Path of pollutants, *Sediments, *Iron, *Organic matter, *Potomac River Estuary, Electron flow, Methane, Food chains, Anaerobic conditions, Chemical reactions, Fermentation.

The potential for ferric iron reduction with fermentable substrates, fermentation products, and complex organic matter as electron donors was investigated with sediments from freshwater and brackish water sites in the Potomac River Estuary. In enrichments with glucose and hematite, iron reduction was a minor pathway for electron flow, and fermentation products accumulated. The substitution of amorphous ferric oxyhydroxide for hematite in glucose enrichments increased iron reduction 50-fold because the fermentation products could also be metabolized with concomitant iron reduction. The degree of inhibition of methane production by various forms of ferric iron was related to the effectiveness of these ferric compounds as electron acceptors for the metabolism of acetate. The addition of acetate or hydrogen relieved the inhibition of methane production by ferric iron. The decrease of electron equivalents proceeding to methane in sediments supplemented with amorphous ferric oxyhydroxides was compensated for by a corresponding increase of electron equivalents in ferrous iron. Iron reduction can outcompete methanogenic food chains for sediment organic matter. (Author's abstract)
W87-00982

BIODEGRADATION OF CHLORINATED ETHENES BY A METHANE-UTILIZING MIXED CULTURE,
Cambridge Analytical Associates, Inc., Boston, MA.
M. M. Fogel, A. R. Taddeo, and S. Fogel.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 4, p 720-724, April 1986. 1 fig, 2 tab, 37 ref. EPA Small Business Innovation Research Grant 68-01-4113.

Descriptors: *Fate of pollutants, *Groundwater, *Methane bacteria, Trichloroethylene, Sediments, Vinyl chloride, Anaerobic conditions.

The capability of a liquid culture which contains methane-utilizing bacteria to degrade trichloroethylene (TCE) to CO2 was determined and the possibility that other chlorinated ethenes are similarly degraded was investigated. Reports on the biodegradation of chlorinated ethenes under anaerobic conditions which might occur naturally in groundwater show that these substances degrade very slowly, if at all. A mixed culture containing methane-utilizing bacteria was obtained by methane enrichment of a sediment sample. Biodegradation experiments carried out in sealed culture bottles using 14-C-TCE showed that approximately half of the radioactive carbon had been converted to show 14-CO2 and bacterial biomass. In addition to TCE, vinyl chloride and vinylidene chloride could be degraded to products which are not volatile chlorinated substances and are therefore likely to be further degraded to CO2. Two other chlorinated ethenes, cis and trans-1,2-dichloroethylene degraded to chlorinated products, which appeared to degrade further. A sixth chlorinated ethene, tetrachloroethylene was not degraded by the methane-utilizing culture under these conditions. The biodegradation of TCE was inhibited by acetylene, a specific inhibitor of methane oxidation by methanotrophs. (Author's abstract)
W87-00984

SEASONAL VARIATIONS IN NITRATE CONTENT, TOTAL NITROGEN, AND NITRATE REDUCTASE ACTIVITIES OF MACROPHYTES FROM A CHALK STREAM IN UPPER BAVARIA,
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Botanik und Microbiologie.
A. Melzer, and R. Kaiser.
Oecologia OECOBX, Vol. 69, No. 4, p 606-611, July 1986. 4 fig, 26 ref.

Descriptors: *Nitrates, *Bavaria, *Germany, *Moosach River, *Macrophytes, *Aquatic plants, Nitrogen, Ammonia, Seasonal variation, Plant populations, Nutrient uptake, Leaves, Enzymes, Plant tissues.

Eleven macrophytic species were collected from the Moosach river system north of Munich over a 1-year period and analyzed to determine differences in the endogenous nitrate content, in total nitrogen content, and in nitrate reductase activity (NRA). Nitrate concentrations of different plants taken from the same site varied by a factor of 1000. A maximum of 1,958 micromol NO3(-)/gm dry wt. could be measured in the petioles of Nasturtium officinale, which accounts for 12% of the plant dry wt. High values were also found in Callitriche obtusangula (1,813 micromol/gm dry wt.) and Veronica angallis-aquatica (1,168 micromol/gm dry wt.). In Fontinalis antipyretica, the species with the lowest nitrate accumulations, the ratio between mean nitrate content of the plants to mean nitrate content of the water was 1.24:1. Endogenous nitrate accumulation in the shoot axes of Callitriche obtusangula was 131-fold higher than in the surrounding water. Elodea canadensis also had very low nitrate concentrations. Since NRA was also very low, it is suggested that nitrogen nutrition of this species depends on ammonia rather than on nitrate. No correlation could be found between endogenous nitrate content and NRA. Total nitrogen concentrations of the plants did not differ significantly. (Peters-PTT)
W87-00987

MORPHOLOGY AND CONTENT OF DRY MATTER AND SOME ELEMENTS IN CELLS AND STALKS OF NEVSKIA FROM AN EUTROPHIC LAKE,
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
M. Heldal, and O. Tumyr.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 2, p 89-92, February 1986. 4 fig, 1 tab, 17 ref.

Descriptors: *Bacteria, *Water sampling, *Eutrophic lakes, *Norway, Lake Hjortlandsstemma, Nevskia, Iron, Aluminum, Taxonomy, Bacterial analysis.

Pelagic colonies of Nevskia-like stalked bacteria were found in water samples from Lake Hjortlandsstemma (Western Norway) at 8 to 12 m depth during the autumn circulation. In the samples studied, Nevskia was quite abundant and found together with a planktonic Gallionella. The apical cells of Nevskia were 0.5 to 0.7 micron wide and 1.5 to 3 micron long, curved rods with laterally excreted stalks and without measurable amounts of iron in the cells. The stalks were short and, in some instances, composed of 6 to 8 strands of fibrils. The stalks were also encrusted with iron, aluminum, and other elements. Dry matter content of the cells was 260 to 350 picogram/cell. The organic material excreted as stalks was estimated to be 500 to 1200 femogram/cell. These Nevskia-like bacteria could probably be grouped into the Gallionella genus as Gallionella corenola Dorff 1934, 26, based on both morphology and on metal deposits on the stalks. More thorough investigations of morphological variability under different growth conditions are needed before the taxonomic position of these organisms can be settled. (Peters-PTT)
W87-00988

NOTE ON THE SURVIVAL OF LEGIONELLA PNEUMOPHILIA IN STAGNANT TAP WATER,
Centre for Applied Microbiology Research, Salisbury (England).
G. M. Schofield.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 4, p 333-335, October 1985. 2 fig, 1 tab, 3 ref.

Descriptors: *Bacteria, *Legionella pneumophilia, *Stagnant water, *Drinking water, *Survival, Bacterial analysis, Epidemiology, Flushing.

The survival of Legionella pneumophilia in nonsterile tap water was studied. It was found that Legionella can survive for long periods and reinoculate a hot water system from a stagnant water source when disturbed by a sudden flush of water or when a system is brought into use after a long static period. (Michael-PTT)
W87-01004

NOTE ON THE ATTACHMENT RATE OF SUSPENDED BACTERIA TO SUBMERGED

AQUATIC PLANTS IN A CALCAREOUS STREAM,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 5A.
W87-01008

NOTE ON ANTIBIOTIC-RESISTANT ESCHERICHIA COLI IN ADULT MAN, RAW SEWAGE AND SEWAGE-POLLUTED RIVER TIGRIS IN MOSUL, NINEVA,
Mosul Univ. (Iraq). Dept. of Biology.
M. M. Al-Jebouri, and N. S. Al-Meshhadani.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 6, p 513-518, December 1985. 6 tab, 13 ref.

Descriptors: *Escherichia coli, *Antibiotics, *Wastewater analysis, *Waste characteristics, *Tigris River, Bacterial analysis, Raw wastewater, Wastewater pollution, Epidemiology, Human pathology, Public health, Ampicillin.

The extent to which the River Tigris was contaminated with antibiotic resistant E. coli bacteria is examined. E. coli isolates were collected from healthy human adults, raw sewage and sewage polluted portions of the river over a nine month period. Resistance of the organisms to 11 antimicrobal drugs was evaluated, and of the 40% that were found to be antibiotic resistant, 77.1% were resistant to more than one antibiotic. The minimal inhibitory concentration of ampicillin for 193 selected strains was determined. The high incidence of antibiotic resistant E. coli in this location and the resulting health implications are also discussed. (Michael-PTT)
W87-01009

PERSISTENCE OF LEGIONELLA PNEUMOPHILIA IN NON-STERILE, STERILE AND ARTIFICIAL HARD WATERS AND THEIR GROWTH PATTERN ON TAP WASHER FITTINGS,
Centre for Applied Microbiology Research, Salisbury (England).
G. M. Schofield, and R. Locci.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 6, p 519-527, December 1985. 11 fig, 1 tab, 9 ref.

Descriptors: *Tap water, *Hard water, *Plumbing, *Legionella pneumophilia, *Bacterial analysis, Slime, Materials testing, Electron microscopy, Epidemiology.

Adhesion and growth of Legionella pneumophilia bacteria on domestic tap water fittings was studied over a four month period using a fluorescein-labelled antibody and scanning electron microscopy. Natural sterilized tap water, sterile distilled water and artificial hard water were used with man-made, natural and zinc tap washer fittings. Organisms other than legionella were present and a complex colonization mat embedded in a protective coat of slime and debris was found. The numbers of L. pneumophilia recovered from the water were highest between four and seven weeks, and could still be cultivated after four months. (Michael-PTT)
W87-01010

INFLUENCE OF TEMPERATURE ON THE NUMBER OF LEGIONELLA PNEUMOPHILIA IN HOT WATER SYSTEMS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
D. G. Groothuis, H. R. Veenendaal, and H. L. Dijkstra.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 6, p 529-536, December 1985. 3 fig, 3 tab, 13 ref.

Descriptors: *Legionella pneumophilia, *Water temperature, *Water storage, *Plumbing, Pipes, Flushing, Epidemiology, Decontamination.

The effect of hot water temperature on the incidence and number of Legionella pneumophilia bacteria in the hot water systems of two buildings was studied. Legionella could be isolated from taps, showers and mains when the temperature in the return mains was kept at 54 C. Complete decontamination was not possible even when temperature in the return mains was raised to 70 C and all taps and showers were flushed. This suggests that dead ends in the pipeline network not reached by hot water are a possible source of recontamination. (Michael-PTT)
W87-01011

WILD BIRDS AND SILAGE AS RESERVOIRS OF LISTERIA IN THE AGRICULTURAL ENVIRONMENT,
North of Scotland Coll. of Agriculture, Aberdeen. Bacteriology Div.
D. R. Fenlon.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 6, p 537-543, December 1985. 5 tab 22 ref.

Descriptors: *Water birds, *Silage, *Listeria monocytogenes, *Agriculture, *Scotland, Epidemiology, Bacterial analysis, Feces, Wastewater disposal, Animal diseases, Nesting, Rooks, Seagulls, Wastewater treatment facilities.

Samples of bird feces and silage were examined to determine their role as vectors for transfer of Listeria monocytogenes to farm animals in Scotland. Fecal samples indicated that seagulls feeding at sewage facilities had a higher rate of carriage than those elsewhere. Samples from rooks generally showed a low incidence of Listeria except during the nesting season which indicated a change in feeding habits. Incidence in clump silage was low, but rose to 22.2% in bale silage and 44% in moldy samples. (Michael-PTT)
W87-01012

METABOLISM OF N-ALKANES AND THEIR INCORPORATION INTO LIPIDS IN THE RAINBOW TROUT,
Centre de Recherches de Toulouse (France). Lab. de Recherche sur les Additifs Alimentaires.
J. P. Cravedi, and J. Tulliez.
Environmental Research ENVRAL, Vol. 39, No. 1, p 180-187, February 1986. 2 fig, 3 tab, 21 ref.

Descriptors: *Metabolism, *Organic compounds, *Trout, *Lipids, *Fate of pollutants, *Hydrocarbons, Radioactivity effects, Oxidation, Tissue analysis, Liver, Fatty acids, Radioisotopes, Radiochemical analysis.

Metabolism of n-alkanes by rainbow trout was studied to determine if terminal oxidation is the sole pathway of n-paraffin degradation in fish. One week after dosing with 14-C labeled heptadecane, about 50% of the ingested radioactivity was stored in the carcass. The highest concentration of 14-C was found in adipose tissue and liver, in which 77 and 22%, respectively, of the radioactivity originated from hydrocarbon. The remainder was oxidized to heptadeanioc acid and was incorporated into neutral lipids as free fatty acid and phospholipids. (Michael-PTT)
W87-01015

METABOLIC ENZYME INDUCTION IN THE RAT BY ORGANIC RIVER SEDIMENT POLLUTANTS,
Science Univ. of Tokyo. (Japan). Faculty of Pharmaceutical Sciences.
M. Tabata, J. Suzuki, and S. Suzuki.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 180-186, August 1986. 1 fig, 2 tab, 14 ref. Ministry of Education, Science and Culture (Japan) Grant 5803066.

Descriptors: *Liver enzymes, *River sediments, *Rats, *Toxicity, *Water pollution effects, *Mutagenesis, *Tama River, Daishibashi, Japan, S-9 fractions, Benzo(a)pyrene monoxygenase, Polychlorinated biphenyls, Bioassay, Extracts, Ames assay, Sewage, Industrial wastewater.

The enzyme-inducing ability of river sediment from the mouth of the Tama River (Daishibashi, Japan), which receives 190 t/day domestic sewage and 60 t/day of industrial waste water, was evaluated using S-9 fractions of livers of Sprague-Dawley rats. Rats received a single intraperitoneal injection of 500 mg/kg of solvent extracts of dry river sediment, and liver extracts were obtained 5 days later. Relative benzo(a)pyrene monoxygenase (BPMO)-induction activities of test substances were: polychlorinated biphenyl (PCB, + control), 38.5; ethyl acetate extract of river sediment, 13.0; n-hexane extract, 5.6; methanol extract, 1.9; and olive oil control), 1.0. The respective figures for induction of NADPH-cytochrome c reductase were 1.9, 1.1, 1.2, 1.2, and 1.0. In a second series of experiments, the same substances gave the following relative activities of induction of revertant colonies per 5 microgram (ug) of benzo(a)pyrene with Salmonella typhimurium TA98 in the Ames test: PCB, 6.3; ethyl acetate extract, 1.4, n-hexane extract 0.8; methanol extract, 0.7; and olive oil, 1.0. The respective figures for revertant colonies per 5 ug aminofluorene were 26.5, 6.6, 4.5, 0.9, and 1.0. It was concluded that Tama River sediment contained organic matter that could induce cytochrome P-450 and P-448. (Rochester-PTT)
W87-01028

HEAVY METALS AND SELENIUM VARIATION IN A MIGRATORY BIRD WINTERING IN A MERCURY-POLLUTED LAGOON,
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
For primary bibliographic entry see Field 5C.
W87-01029

HEAVY METAL BIOACCUMULATION AND EFFECTS ON WATERHYACINTH WEEVILS, NEOCHETINA EICHHORNIAE, FEEDING ON WATERHYACINTH, EICHHORNIA CRASSIPES,
Delta State Univ., Cleveland, MS. Center for Alluvial Plains Studies.
For primary bibliographic entry see Field 5C.
W87-01030

MERCURY CONTAMINATION IN GUADALQUIVIR RIVER MARSHES, SPAIN, USING SAMARUGO, VALENCIA HISPANICA, AS BIOLOGICAL INDICATOR,
Cordoba Univ. (Spain). Dept. de Higiene.
For primary bibliographic entry see Field 5A.
W87-01031

ACUTE TOXICITY OF SAPONIFIED CASTOR OIL TO CHANNEL CATFISH, ICTALURUS PUNCTATUS, UNDER LABORATORY AND FIELD CONDITIONS,
Mississippi Agricultural and Forestry Experiment Station, Mississippi State.
For primary bibliographic entry see Field 5C.
W87-01036

CADMIUM TRANSPORT, RESISTANCE, AND TOXICITY IN BACTERIA, ALGAE, AND FUNGI,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5C.
W87-01038

AIR, LAND, WATER ANALYSIS SYSTEM (ALWAS): MULTI-MEDIA PATHWAYS OF ORGANIC POLLUTANTS IN FRESHWATER SYSTEMS,
Environmental Science and Engineering, Inc., Gainesville, FL.
W. A. Tucker, and K. F. Hedden.
Journal of Environmental Science and Health (A) JESEDU, Vol. 21, No. 5, p 449-481, July 1986. 7 fig, 1 tab, 7 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Air-land-water analysis system, *Simulation, *Multi-media environmental models, Runoff, Benzo(a)pyrene, Watershed, Nonpoint pollution sources, Mathematical models.

The structure, scope and limitations, features, and inputs and outputs of the air, land, water analysis system (ALWAS) are described, and the results of

a hypothetical test simulation, including sensitivity analysis, are presented. ALWAS is a multi-media environmental model for describing the atmospheric dispersion of toxicants, the surface runoff of deposited toxicants, and the subsequent fate of these materials in surface water bodies. ALWAS depicts the spatial and temporal distribution of contaminant concentrations in a watershed and in the air above it. Linked in ALWAS are three submodels that provide for independent and partially coupled usage modes Dispersion and Deposition of Toxics, a modification called NPSDEP of the Non-point Source Model, and Exposure Analysis Modeling System. In the hypothetical example, benzo(a)pyrene output from a small watershed was determined. For the conditions used ALWAS water quality results were much more sensitive to uncertainties in the deposition parameters than to uncertainties in sediment washoff. (Rochester-PTT)
W87-01045

BENZO(A)PYRENE OXIDATION AND MICROSOMAL ENZYME ACTIVITY IN THE MUSSEL (MYTILUS EDULIS) AND OTHER BIVALVE MOLLUSC SPECIES FROM THE WESTERN NORTH ATLANTIC,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. J. Stegeman.
Marine Biology MBIOAJ, Vol. 89, No. 1, p 21-30, October 1985. 3 fig, 6 tab, 45 ref. DOC Sea Grant NA-80-AA-D-00077, NSF Grants OCE-80-18569 and OCE-83-10505.

Descriptors: *Benzo(a)pyrene, *Path of pollutants, *Fate of pollutants, *Oxidation, *Microsomal enzymes, *Mussels, *Mollusks, *Cytochrome P-450, Carcinogen, Metabolism, Chromotography, Spectroscopy, Atlantic Ocean, Seasonal variations, Subcellular fractions.

Analysis of subcellular fractions revealed a complement of microsomal electron transport components, including reductases and heme proteins, in several organs of the bivalves Mytilus edulis, Macrocallista maculata, and Arca zebra. Dithionite difference spectroscopy of CO-treated microsomes yielded spectra typical of cytochrome P-450 in digestive gland and gill, with absorption maxima at 450 nm. A time-dependent reduction of cytochrome P-450 also was observed. The levels of these components and rates of microsomal benzo(a)pyrene (BP) metabolism were highest in the digestive gland and were very similar among the species. In Medulis there was a suggested seasonal variation in BP metabolism but no population differences in this activity or in levels of other components. Digestive gland microsomal metabolites of BP identified by high-performance liquid chromatography retention and UV spectroscopy included BP-1,6-quinone, BP-3,6-quinone, and BP-6,12-quinone, which comprised 65% of the total metabolites, and phenols, the latter products consistent with cytochrome P-450 monooxygenation and epoxide hydrolase function. Catalyst(s) in addition to cytochrome P-450 may be acting in BP metabolism. (Rochester-PTT)
W87-01052

BIOKINETICS OF PLUTONIUM, AMERICIUM, AND CALIFORNIUM IN THE MARINE ISOPOD CIROLANA BOREALIS, WITH OBSERVATIONS ON ITS FEEDING AND MOLTING BEHAVIOR,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
F. P. Carvalho, and S. W. Fowler.
Marine Biology MBIOAJ, Vol. 89, No. 2, p 173-181, November 1985. 2 fig, 5 tab, 49 ref. IAEA Contract POR/8108.

Descriptors: *Path of pollutants, *Fate of pollutants, *Plutonium-237, *Americium-241, *Californium-252, *Isopods, *Isotope studies, *Bioaccumulation, Feeding, Molting, Isotopic tracers, Depuration, Digestion, Exoskeleton, Radioactive wastes, Marine environment.

The biokinetics of 237Pu(IV), 237Pu(V), 241Am(III), and 252Cf(III) in Cirolana borealis Lilljeb. were studied in a series of laboratory experiments. Following a 3-wk exposure to labelled seawater, the isopods reached non-equilibrium concentration factors of 52 + or - 15, 54 + or - 12, 176 + or - 14, and 185 + or - 53 for Pu(IV), Pu(V), Am, and Cf, respectively. Uptake occurred to a great extent by surface adsorption, with the major fraction of the accumulated radionuclides being associated with the exoskeleton and lesser percentages located in the gut, digestive gland, muscle, and hemolymph. The pattern of radiotracer depuration was always biphasic, with the long-lived retention compartment retaining the largest fraction of whole-body radioactivity. After long-term depuration, it was observed that radionuclides were eliminated more rapidly from internal tissues than from the exoskeleton. Unassimilated labelled food often was retained in the gut for more than 2 mo and released only infrequently in a loosely bound condition. The feeding-digestive strategy observed in these highly mobile, scavenging isopods potentially could act as a biological mechanisms for the widespread dispersion of radioactive wastes introduced by contamination of the environment. (Rochester-PTT)
W87-01058

QUANTITATIVE DISTRIBUTION OF THE MEIOFAUNA IN THE VICINITY OF MARSEILLES' SEWAGE OUTFALL (DISTRIBUTION QUANTITATIVE DE LA MEIOFAUNE DANS L'AIR D'EPANDAGE DE L'EGOUT DE MARSEILLE),
Aix-Marseille-3 Univ. (France). Lab. de Biologie des Invertebres Marine.
For primary bibliographic entry see Field 5C.
W87-01060

PARTICULATE DNA IN SUBTROPICAL OCEANIC AND ESTUARINE PLANKTONIC ENVIRONMENTS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W87-01062

UPTAKE AND TRANSLOCATION OF PHOSPHORUS IN EELGRASS (ZOSTERA MARINA),
Aarhus Univ. (Denmark). Botanical Inst.
H. Brix, and J. E. Lyngby.
Marine Biology MBIOAJ, Vol. 90, No. 1, p 111-116, December 1985. 5 fig, 2 tab, 27 ref.

Descriptors: *Eelgrass, *Bottom sediments, *Phosphorus-32, *Cycling nutrients, *Absorption, *Translocation, *Autoradiography, Isotope studies, Plant growth, Plant physiology, Light, Leaves, Roots, Rhizomes.

The uptake and translocation of P in Zostera marina L. was studied in two-compartment chambers using 32P and autoradiography. Eelgrass was able to take up P both with leaves and root-rhizomes. Only a small amount (<4%) of the total P taken up from either source was translocated within the plant during an incubation time of 120 hr. Release of translocated P to the surrounding water was not detected. Translocated P was localized in actively-growing tissues. The uptake of P in leaves and the bidirectional translocation in the plants was significantly lower in the dark. The uptake of P in root-rhizomes was unaffected by light-conditions. The concentration of P in one compartment did not affect the uptake of P by plant parts in the other compartment, but uptake in both compartments was reduced significantly when both compartments were supplied with identical P concentrations. The present results suggest that the quantitative importance of eelgrass in cycling of P between the sediment and the water may have been greatly overestimated in earlier studies. (Rochester-PTT)
W87-01063

TRACE METALS IN MUSSELS (MYTILUS EDULIS) FROM SOUTHWEST ICELAND,
Marine Research Inst., Reykjavik (Iceland).
J. Olafsson.
Marine Biology MBIOAJ, Vol. 90, No. 2, p 223-229, January 1986. 3 fig, 5 tab, 39 ref.

Descriptors: *Trace metals, *Mussels, *Iceland, Reykjavik, Europe, Water pollution sources, Mercury, Cadmium, Copper, Zinc, Lead, Gasoline, Paints, Urban areas, Nonpoint pollution sources.

The concentrations of Hg, Cd, Pb, Cu, and Zn were determined in Mytilus edulis from 48 locations in southwest Iceland, as well as in moored mussels. Thirty-four locations away from population centers were selected as reference stations. Data on metal content of soft tissues were examined in relation to both tissue weight and shell length. Pb and Hg contamination were revealed in mussels from the vicinity of Reykjavik; leaded gasoline, paints, and diffuse urban uses are considered as sources. Results are compared with published mussel watch results from Europe. (Rochester-PTT)
W87-01065

ADAPTIVE MICROSTRUCTURE OF THE SPINES OF PARACENTROTUS LIVIDUS (ECHINODERMATA: ECHINODEA) IN AN AREA POLLUTED BY DOMESTIC EFFLUENT (MICROSTRUCTURE ADAPTATIVE DES RADIOLES DE PARACENTROTUS LIVIDUS (ECHINODERMATA: ECHINOIDEA) EN MILIEU EUTROPHISE PAR DES EAUX USEES),
Aix-Marseille-3 Univ. (France). Faculte des Sciences et Techniques.
For primary bibliographic entry see Field 5C.
W87-01066

CONTRIBUTION TO THE ECOTOXICOLOGICAL STUDY OF CADMIUM, LEAD, COPPER, AND ZINC IN THE MUSSEL MYTILUS EDULIS: I. FIELD STUDY,
Nantes Univ. (France). Centre de Dosage des Elements Traces.
J. C. Amiard, C. Amiard-Triquet, B. Berthet, and C. Metayer.
Marine Biology MBIOAJ, Vol. 90, No. 3, p 425-431, February 1986. 1 fig, 6 tab, 29 ref. Ministry of Environment (France) Grant 83187.

Descriptors: *Water pollution effects, *Heavy metals, *Mussels, *Toxicity, *Bay of Bourgneuf, *Seasonal distribution, Growth, France, Cadmium, Lead, Copper, Zinc, Pollution index.

Factors that condition bioaccumulation in Mytilus edulis L. were studied using samples obtained monthly from March 1982 to May 1984 in the Bay of Bourgneuf, France. Maximal levels of metals were observed in winter and early spring and minimal levels in later spring and summer. Fluctuations in soft-tissue weight appeared to be the main factor explaining seasonal variations in metal concentrations in the mussels. Except for Cd in mussels with a mean dry weight of soft tissue > 0.2 g, a slight decrease in metal concentration was observed for growing individuals. The regression coefficient, b, for the relationship between metal concentration and soft tissue dry weight were -0.10, -0.11, -0.13, and -0.27 for Cd, Cu, Zn, and Pb, respectively. The metals were rather uniformly distributed among the different groups of organs (visceral mass, gills and palps, and 'remainder'). Fluctuations in metal content of soft tissue related to size or season are reflected by only moderate differences in the maximum and minimum concentrations of metals in the mussels, but they are nevertheless sufficient to conceal low chronic or short-term pollution, except at those sites where the 'normal' environmental conditions are well-documented. (Rochester-PTT)
W87-01067

COMPOSITION OF SNOW IN PACIFIC COASTAL MOUNTAINS,
Atmospheric Environment Service, Downsview (Ontario).
G. A. McBean, and S. Nikleva.
Atmospheric Environment ATENBP, Vol. 20, No. 6, p 1161-1164, June 1986. 2 fig, 7 ref, 1 append.

Descriptors: *Snow sampling, *Acid rain, *Chemical analysis, *British Columbia, Hydrogen ion concentration, Sulfate, Heavy metals, Nitrate, Ammonium, Canada, Georgia Strait, Vancouver, Sea salt, Air pollution.

A snow collection program was conducted in March 1982 in the mountainous regions of southwestern British Columbia (Canada). The spatial distribution of the snow's chemical composition was determined from the 18 locations sampled. In remote areas ion concentrations were low and the pH was near 5.4. There was an appreciable sea salt component on windward slopes. Nitrate and ammonium appeared to be associated in the form of ammonium nitrate. Near Georgia Strait and Vancouver the pH was depressed to near 5 with increased sulfate and nitrate concentrations. There also were enhanced levels of heavy metals in the snow. Further inland, the pH increased but not to remote values. The sulfate concentration decreased but enhanced levels of nitrate remained. (Author's abstract)
W87-01068

WINTERTIME WET AND DRY DEPOSITION IN NORTHERN MICHIGAN,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
S. H. Cadle, J. M. Dasch, and R. Van de Kopple.
Atmospheric Environment ATENBP, Vol. 20, No. 6, p 1171-1178, June 1986. 5 fig, 6 tab, 13 ref.

Descriptors: *Precipitation, *Michigan, *Winter, *Seasonal distribution, Bucket method, Snow sampling, Hydrogen ion concentration, Sulfate, Nitrate, Ammonium, Calcium, Magnesium, Sodium, Potassium, Chlorides, Ions, Deciduous canopy, Red pine canopy, Snowpack.

Wet and dry deposition were monitored at a station near the tip of Michigan's lower peninsula, approximately 350 km north of Detroit for three winters. Dry deposition was measured by the conventional bucket method and by measuring increases in concentration in exposed, elevated snow samples. Average results of the two methods were in reasonable agreement. The cumulative wet and dry deposition quantities agreed well with snowpack accumulations until the first thaw period. Dry deposition to snow accounts for less than 15% of the total H(+), SO4(2-), NO3(-), and NH4(+) and approximately 25% of the Ca(2+), Mg(2+), Na(+), K(+), and Cl(-) during an average precipitation year. Snowpack measurements also were made under deciduous and red pine canopies. Decreases in H(+) and NO3(-) were observed under the red pine canopy. (Author's abstract)
W87-01069

URBAN DEW: ITS COMPOSITION AND INFLUENCE ON DRY DEPOSITION RATES,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 2B.
W87-01071

REGIONAL-SCALE PRECIPITATION SCAVENGING OF SO2, SO4, NO3, AND HNO3,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
W. H. Chan, and D. H. S. Chung.
Atmospheric Environment ATENBP, Vol. 20, No. 7, p 1397-1402, July 1986. 4 tab, 31 ref.

Descriptors: *Acidic Precipitation in Ontario Study, *Sulfur dioxide, *Sulfates, *Nitrates, *Nitric acid, *Precipitation scavenging, *Air pollution, *Acid rain, Rain, Snow, Canada.

Daily air and precipitation concentration data from monitoring sites in the APIOS (Acidic Precipitation in Ontario Study) network were examined to yield rain and snow scavenging ratios of SO2, SO4(2-), NO3(-), and HNO3. Rain was more efficient in scavenging SO4(2-) than SO2; snow was slightly more efficient than rain in scavenging SO4(2-). The scavenging of SO2 by snow was negligible. Both rains and snow were more efficient in scavenging HNO3 than NO3(-). Whereas the scavenging efficiencies of HNO3 by rain and snow were comparable, snow was more efficient than rain in scavenging NO3(-). On an annual basis, scavenging ratios (W) derived from precipitation (mg/l) and air (microgram/l) concentrations, are estimated for SO4(2-) to be 430,000, for SO2 to be 46,000, for NO3(-) to be 470,000, and for HNO3 to be 840,000. On average, direct scavenging of ambient air SO2 and NO3(-) accounts for less than 15% of SO4(2-) and NO3(-) in precipitation. (Author's abstract)
W87-01072

INTERLABORATORY COMPARISONS OF THE DETERMINATION OF PH IN POORLY BUFFERED FRESH WATERS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5A.
W87-01074

OCCURRENCE OF MONOALKYLLEAD SPECIES DURING THE SPECIATION OF ORGANOLEAD,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
R. J. A. Van Cleuvenbergen, D. Chakraborti, and F. C. Adams.
Analytica Chimica Acta ACACAM, Vol. 182, p 239-244, April 30, 1986. 1 fig, 1 tab, 16 ref. FKFO (Belgium) Grant 2.0091.85, EC Grant 768-B/RS.

Descriptors: *Path of pollutants, *Lead, *Chemical analysis, *Grignard derivatization, *Organolead, Trialklyllead, Dialkyllead, Monoalkyltributyllead.

When tri- and dialkyllead levels are determined in environmental samples by a method based on Grignard derivatization and subsequent gas chromatography/atomic absorption spectrometry, monoalkyllead species are sometimes detected. A rearrangement process occurring during or following Grignard derivatization explains this occurrence at least partly. The accuracy of the determination does not suffer significantly from this limited-scale reaction, but the detection of a monoalkyltributyllead species does not mean necessarily that the sample contains monoalkyllead compounds. (Author's abstract)
W87-01075

MINE WASTE POLLUTION OF THE MOLONGLO RIVER, NEW SOUTH WALES AND THE AUSTRALIAN CAPITAL TERRITORY: EFFECTIVENESS OF REMEDIAL WORKS AT CAPTAINS FLAT MINING AREA,
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
For primary bibliographic entry see Field 5C.
W87-01083

PHOTOOXIDATION OF THIOETHER PESTICIDES ON SOIL SURFACES,
Nevada Univ., Reno. Dept. of Biochemistry.
K. Gohre, and G. C. Miller.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 4, p 709-713, July-August 1986. 8 fig, 2 tab, 21 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Oxidation, *Pesticides, *Disulfoton, *Methiocarb, *Butocarboxim, *Fenthion, *Chemical degradation, *Soil surfaces, Sulfer, Thioether pesticides, Irradiation, Oxygen, Organic soils.

Four thioether pesticides (disulfoton, methiocarb, butocarboxim and fenthion) were exposed to sunlight to determine whether each undergoes photochemical conversion to the sulfoxide when sorbed on soil. Disulfoton experienced the most rapid loss on the three soils studied while methiocarb degraded most slowly. The probable oxidant forming the sulfoxides is singlet oxygen, but other oxidation pathways are possible. Sulfoxide production was not shown to be caused by metabolic processes. The lowest organic content soil gave the most rapid degradation rates. Conversion rates of sulfur-containing pesticides were rapid enough to demonstrate that photooxidation is an important transformation pathway for these compounds on soil surfaces. (Michael-PTT)
W87-01117

RESIDUES OF ALDICARB AND FENAMIPHOS IN SOIL, LEAVES, AND FRUIT FROM A TREATED VINYARD,
Plant Protection Research Inst., Pretoria (South Africa).
M. Krause, J. T. Loubser, and P. R. de Beer.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 4, p 717-720, July-August 1986. 1 tab, 12 ref.

Descriptors: *Path of pollutants, *Nematocides, *Vine crops, *Metabolites, *Aldicarb, *Fenamiphos, *Oxidation, Sulfoxides, Sulfone, Soil contamination, Plant tissues, Fruit crops.

A study was conducted to determine whether unacceptably high concentrations of total aldicarb (TA) or total fenamiphos (TF) were present in harvested grapes after applications at dosages used in other crops and to compare leaching and persistance of the compounds in soil. The nematocides were applied over the entire area and in bands on either side of the rows of vines. A gas chromatograph with packed columns was used to determine TA and TF residues in the roots, soil, leaves and fruit from treated vinyards. No TA residues were present 28 days after application, but TF residues were still present in the 30-60 centimeter soil layer. Fruit samples contained less than 0.01 milligram per kilogram of TA and less than 0.02 milligram per kilogram of TF at harvesting. Band application resulted in a lower maximum leaf concentrtion of TA, but a higher concentration of TF. (Michael-PTT)
W87-01118

METABOLISM OF ALACHLOR AND PROPACHLOR IN SUSPENSIONS OF PRETREATED SOILS AND IN SAMPLES FROM GROUND WATER AQUIFERS,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
N. J. Novick, R. Mukherjee, and M. Alexander.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 4, p 721-725, July-August 1986. 2 fig, 1 tab, 16 ref. USDA Agreement USDA-TPSU-2057-261, EPA Assistance Agreement CR809735-02-0.

Descriptors: *Path of pollutants, *Fate of pollutants, *Metabolism, *Herbicides, *Soil absorption capacity, *Aquifers, *Microorganisms, *Microbial degradation, *Mineralization, Alachlor, Propachlor, Leaching, Soil types, Trace levels.

A study was conducted to determine whether soil suspensions treated with the herbicides alachlor and propachlor would mineralize these compounds and whether samples from ground water aquifers into which the herbicides might leach would metabolize them and whether microorganisms capable of mineralizing the compounds could be isolated. Alachlor was not as completely nor as rapidly mineralized as propachlor by various soil types. Microorganisms capable of mineralizing alachlor could not be isolated. Samples from ground water aquifers mineralized less than one percent of the herbicides at the lower concentrations, but four organic products were formed from the alachlor. A mixture of two bacteria mineralized 57.6 percent of ring-labeled propachlors in 52.5 hours and a product of microbial metabolism was identified as N-isopropylaniline. Study results suggest that mineralization is a major means for soil destruction of propachlor but not for alachlor. (Michael-PTT)
W87-01119

HEAVY-METAL ABSORPTION BY SOYBEAN ON SEWAGE SLUDGE TREATED SOIL,
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
M. R. Reddy, and S. J. Dunn.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 4, p 750-753, July-August

1986. 2 fig, 4 tab, 28 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Absorptions, *Soybeans, *Digested sludge, *Soil absorption capacity, Cadmium, Nickel, Curium, Sludge utilization, Plant tissues, Seeds, Zinc.

Absorption and distribution of the heavy metals cadmium, nickel, zinc and curium by Bragg and Ransom varieties of soybeans from sludge treated soil was studied. The soybeans exhibited significant differences in absorption of cadmium and curium. Concentrations of heavy metals varied significantly among the different tissues of the plants. Cadmium concentrations increased more than zinc concentrations on the basis of background level. Nickel concentration was increased to the greatest extent by sludge-applied metals. Heavy metal concentrations in soybean seed were below the recommended limit for livestock. (Author's abstract)
W87-01120

GEOCHEMICAL BEHAVIOR OF ALUMINUM IN ACIDIFIED SURFACE WATERS,
Geological Survey, Menlo Park, CA.
D. K. Nordstrom, and J. W. Ball.
Science SCIEAS, Vol. 232, No. 4746, p 54-56, April 4, 1986. 1 fig, 20 ref.

Descriptors: *Geochemistry, *Aluminum, *Acid mine drainage, Hydrogen ion concentration, Chemical properties, Chemical reactions, Equilibrium, Solubility, Gibbsite, Aluminum hydroxide.

Water sampling from a drainage basin containing acid mine water revealed that, when a broad enough range of pH has been measured, aluminum shows both conservative (nonreacting) and nonconservative (reacting) behavior in modified stream water. Behavior transition occurs in the pH range of 4.5 to 5.0. Nonconservative behavior is closely correlated with the equilibrium solubility of a microcrystalline gibbsite or amorphous aluminum hydroxide. (Michael-PTT)
W87-01138

FATE OF FOREIGN COMPOUNDS IN THE ENVIRONMENT,
A. C. Anderson, and A. A. Abdelghani.
Journal of Community Health JCMHB, Vol. 10, No. 3, p 172-179, Fall 1985. 1 fig, 26 ref.

Descriptors: *Fate of pollutants, *Arsenic compounds, Environment, Toxicity, Chemical properties, Ecosystems, Transport depletion.

The parameters that must be considered when predicting the fate of a compound in the environment and its toxicity to organisms are listed. These include chemical characteristics, ecosystem characteristics and transport processes. An example is given which relates these factors to the distribution and fate of arsenical compounds in the environment. (Michael-PTT)
W87-01139

HEAVY METALS IN FISH FROM A SERIES OF METAL-CONTAMINATED LAKES NEAR SUDBURY, ONTARIO,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-01142

TEMPORAL STUDY OF COLLOIDAL AND DISSOLVED ORGANIC CARBON IN RIVERS: APPARENT MOLECULAR WEIGHT SPECTRA AND THEIR RELATIONSHIP TO BACTERIAL ACTIVITY,
University Coll. of North Wales, Bangor. School of Animal Biology.
For primary bibliographic entry see Field 2H.
W87-01152

SIMULATED REGIONAL VARIATIONS IN PESTICIDE RUNOFF,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Haith.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 1, p 5-8, January-March 1986. 1 fig, 6 tab, 17 ref.

Descriptors: *Runoff, *Water pollution sources, *Path of pollutants, *Pesticides, *Model studies, *Mathematical models, *Fate of pollutants, Insecticides, Hydrology, Soil chemistry, Weather, Atrazine, Carbofuran.

Mathematical models for daily weather, hydrology, and soil chemistry were combines in a general approach for estimating pesticide runoff. Runoff losses of atrazine and carbofuran were simulated for hypothetical 9-ha corn fields in New York, Georgia, Iowa, Texas, and Kentucky. Two representative soils were considered: a well-drained sandy loam and a poorly-drained silty clay loam. Each case was simulated for 100 yr by a Monte Carlo process to produce 100 samples of annual pesticide runoff. Mean annual pesticide losses ranged from 0.7 to 6.3% of application for atrazine and from 0.8 to 11.4% for carbofuran. Statistical analyses of the samples indicated that soil type affects pesticide runoff, with the silty-clay loam producing significantly greater losses than the sandy loam. Regional similarities and differences were also identified. New York pesticide losses were significantly lower than those from the other four sites. Pesticide runoff values from Georgia and Texas were statistically similar. Variations in pesticide runoff are largely explained by seasonal runoff volume. Regressions on mean runoff volume during the month of pesticide application explained more than 89% of the observed variation in mean annual pesticide in runoff. (Author's abstract)
W87-01154

DECOMPOSITION OF POTATO PROCESSING WASTES IN SOIL,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. H. Smith.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 1, p 13-16, January-March 1986. 3 fig, 4 tab, 13 ref.

Descriptors: *Fate of pollutants, *Decomposition, *Soil, *Wastes, *Food-processing wastes, *Land disposal, Industrial wastes, Organic wastes.

Solid filtered or centrifuged potato processing wastes were obtained from three potato processors in Idaho and added to soils at rates of 0, 2.5, 10, and 25 g/kg. Decomposition of the added wastes was determined by measuring CO2 evolution in a flowing air stream passing over the soil in the incubation flask. Each increment of added organic waste material increased the amount of carbon evolved during the 12-week incubation. The waste materials contained 6.8, 20.4, or 65.5 g N/kg waste. However, these differences in N did not change the amount of CO2 evolved at the 12-week incubation, although the evolution curves were shaped somewhat differently during the 12 weeks. Regression analyses of the cumulative carbon resulted in highly significant R square values being obtained for each potato processing waste material. Decomposition of the solid waste materials ranged from 24 to 92% depending upon the source and application rate. the rapid decomposition of the solid wastes verified field research indicating that potato wastes have not more than 1 yr residual fertilizer value. The organic waste is not likely to accumulate in the field. (Author's abstract)
W87-01155

INTERFLOW, OVERLAND FLOW AND LEACHING OF NATURAL NUTRIENTS ON AN ALFISOL SLOPE OF SOUTHERN BAHIA, BRAZIL,
Cacao Research Center, Itabuna (Brazil). Div. of Geosciences.
J. de O. Leite.
Journal of Hydrology, JHYDA7, Vol. 80, No. 1/2, p 77-92, September 15, 1985. 2 fig, 8 tab, 16 ref.

Descriptors: *Nutrients, *Slopes, *Overland flow, *Brazil, *Flow, *Leaching, Hydrology, Rainfall-runoff relationships, Cropland, Runoff, Calcium, Magnesium, Sodium, Potassium, Nitrogen, Phosphorus, Iron, Seasonal variation.

Volumes of overland flow and interflow were measured daily and samples analyzed monthly for Ca, Mg, Na, K, N, P, and Fe on a slope of Alfisol planted with cacao in Bahia, Brazil. The highest overland-flow volumes represented 24% and the highest interflow 53% of the rainfall, but on the average the volumes of overland flow and interflow represented 1 and 14% of the annual rainfall. The percentage of interflow increases with increasing rainfall. In winter, it is higher than in summer, except during the highest rains observed. The mean annual loss for calcium was 85.8 kg per hectare per year; for magnesium 18.2; potassium 17.0; sodium 23.5; nitrogen 22.1; iron 5.5; and phosphorus 0.9. In relative terms, the K losses are highest, indicating that this element is most leachable. The interflow volumes and the amounts of Na, K, N, and P correlated at the 1% significance level in both plots. In general, the leaching of nutrients varied with the intensity of the interflow (especially for Na, K, N, and P), the leaching of nutrients through overland flow being of less importance. (Author's abstract)
W87-01167

ESTIMATE OF DISPERSION IN AN UNSATURATED AQUIFER,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
D. Stephenson, and A. S. M. de Jesus.
Journal of Hydrology, JHYDA7, Vol. 81, No. 1/2, p 45-55, October 30, 1985. 8 fig, 1 tab, 7 ref.

Descriptors: *Model studies, *Path of pollutants, *South Africa, *Soil dispersivity, *Aquifers, *Groundwater pollution, *Radioactive waste disposal, Mathematical models, Saturated soils, Waste disposal.

The Nuclear Development Corporation of South Africa is constructing a low-level radioactive waste disposal site in an arid region west of South Africa. A groundwater model was developed which requires site-specific data; this work describes procedures for assessing the dispersivity of the soil. Preliminary laboratory tests using a sodium chloride solution various levels. The site tests were then done by injecting a pulse of scandium-46 into a hole and monitoring the displacement of the radioactive cloud as it moved down under gravity and spread laterally. A mathematical model was developed to predict the behavior of the cloud. Calibration of the model yielded vertical and horizontal dispersivities. The dispersion of radioactivity at the cloud front was assumed to occur in unsaturated medium, while the continuously injected water behind the radioactivity was assumed to disperse in a saturated medium. Thus, monitoring the concentration of both yielded approximate values for the effective dispersivities in unsaturated and saturated media. (Doria-PTT)
W87-01172

SEDIMENT AND NUTRIENT DISCHARGE THROUGH STREAMFLOW FROM TWO EXPERIMENTAL WATERSHEDS IN MATURE OAK-BEECH FOREST ECOSYSTEMS NEAR ISTANBUL, TURKEY,
Istanbul Univ. (Turkey). Faculty of Forestry.
A. N. Balci, N. Ozyuvci, and S. Ozhan.
Journal of Hydrology JHYDA7, Vol. 85, No 1/2, p 31-47, June 15, 1986. 11 fig, 5 tab, 8 ref.

Descriptors: *Sediment discharge, *Nutrient removal, *Stream discharge, *Watersheds, *Forest watersheds, *Istanbul, Turkey, Calibrations, Suspended sediments, Catchment areas, Groundwater basins, Sediments, Water yield, Water management.

Initial results are summarized for the 17 months of the calibration phase of a paired watershed experiment from two experimental wathersheds in mature oak-beech forest ecosystems near Istanbul, Turkey. The water discharge from wathershed IV is usually higher during the rainy season tha that

from watershed I, but this trend reverses during the dry season. Annual suspended sediment loads are low, of the order of 60-80 kg per hectare per the rarte of streamflow. Average monthly loss of nutrients correlates significantly with streamflow. Regression equations are presented for these relations. Annual losses of Ca, Mg, Cl, HC03, and Na are substantially higher than for K, N, and P. The losses of N are 3-4 kg per hectare per year, and those for P around 0.4 kg per hectaree per year. (Author's abstract)
W87-01179

PRELIMINARY ASSESSMENT OF THE REGIONAL DISPERSIVITY OF SELECTED BASALT FLOWS AT THE HANFORD SITE, WASHINGTON, U.S.A.,
Texas A and M Univ., College Station. Dept. of Geology.
A. M. Lavenue, and P. A. Domenico.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 151-167, June 15, 1986. 9 fig, 1 tab, 12 ref. Basalt Waste Isolation Project (Rockwell International).

Descriptors: *Path of pollutants, *Groundwater movement, *Basalts, *Hanford Site, *Model studies, *Dispersivity, *Fate of pollutants, *Malenclaves, Washington, Tracers, Environmental tracers, Crystalline rocks, Groundwater pollution, Water pollution, Radioactive waste disposal, Nuclear power plants.

Dispersivity is one of the hydraulic parameters controlling the distribution in groundwater of chemical constituents migrating from a source region. Suitable environmental tracers normally result from some natural event in the geologic past. Such an event may have occurred at the U.S. Department of Energy Hanford Site in the State of Washington, resulting in a chemical enclave of regional proportions. A preliminary interpretation is that the enclave occurs immediately down-gradient from a hydraulic barrier, possibly a fault, which may have placed deeper formations in hydraulic connection with the upper basalts. With this hypothesized source for constituents making up the enclave, the observed concentrations were employed in a preliminary attempt to assess the regional dispersivity. The mathematical method employed assumes that the symmetrical enclave, and part of the problem deals with identifying that symmetry. The results obtained are reasonable compared to the range in dispersivities determined in laboratory, tracer, and model-scale studies. (Author's abstract)
W87-01186

STUDY OF TRACER MOVEMENT THROUGH UNSATURATED SAND,
Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
For primary bibliographic entry see Field 2F.
W87-01187

CROPLAND SOURCES OF WATER POLLUTION,
Resources for the Future, Inc., Washington, DC.
H. M. Peskin.
Environment ENVTAR, Vol. 28, No. 4, p 30-34, 44, May 1986. 3 fig,1 tab, 7 ref.

Descriptors: *Water pollution sources, *Cropland sources, *Clean Water Act, *Croplands, *Nonpoint pollution sources, Cultivated lands, Water pollution control.

There has been a growing perception that the original objectives of the Clean Water Act will not be realized unless more attention is directed toward nonpoint sources of water pollution, which include runoff from urban streets, rangeland, pastureland, forestland, cropland, and stream-bank erosion. Because cropland is an important source of sediment and related pollutants, it has attracted much of the attention of policy analysts. The erosion of cropland soils has been a major concern of agricultural policymakers for over 50 years. This concern has been largely grounded in the fear that the on-farm damages caused by erosion will effect the land's ability to support crops. While concerns about off-farm damages have held a lower societal priority, recent research suggests that the costs to society of these off-farm damages-such as water pollution, sedimentation, and eutrophication-may exceed the value of on-farm losses in crop production. Depending on the decay rate of particular sediment-related pollutants, interstate transport of pollutants can be a major determinant of downstream water quality. This suggests the need for at least a regional policy approach. If the pollutant of concern, only has cropland origins, then an exclusive cropland focus would be appropriate. It might be worthwhile to investigate indirect control strategies for difficult-to-control nonpoint sources. (Khumbatta-PTT)
W87-01202

CADMIUM BIOACCUMULATION STUDIES IN THE FRESHWATER MOLLUSCS ANODONTA CYGNEA AND UNIO ELONGATULUS,
Padua Univ. (Italy). Dept. of Biology.
A. Cassini, L. Tallandini, N. Favero, and V. Albergoni.
Comparative Biochemistry and Physiology CBPCB5, Vol. 84C, No. 1, p 35-41, 1986. 4 fig, 3 tab, 45 ref. National Research Council (Italy) Grant 83.02.075.56 subproject 5, ob 64; CEE ENV 568-I.

Descriptors: *Bioaccumulation, *Mollusca, *Anodonta Cygnea, *Cadmium, *Unio Elongatulus, Toxicity, Biological magnification, Bivales, Heavy metals.

Heavy metal can exert a toxic action on organisms; the features and intensity of damage depend on the nature and level of the metal. Regulation is generally assumed for essential metals, through which metal levels remain under the limits of toxicity for the organism. An analogous process has rarely been described for non-essential metals. Cadmium is a non-essential metal which certainly interacts with the metabolism of divalent essential metals at different subcellular levels and may be accumulated into tissues. The effects of cadmium exposure have been studied in two freshwater bivalves, Anodonta cygnea and Unio elongatulus. Cadmium exposure induces an unremarkable cadmium uptake in the tissues of both the organisms. The low metal concentration in the tissues together with the absence of suffering seem to indicate the presence of some kind of regulation. Cadmium exposure has little effect on copper and zinc levels and distribution indicating little interaction between cadmium and divalent essential metals in these organisms. The percentage distribution of cadmium fractions obtained from Sephadex G-75 varies with metal, organism and tissue suggesting that high molecular weight metal chelating compounds are actually present in the organisms. The detoxification capabilities of different organisms are discussed in relation to the differences found in two closely related freshwater animals. (See also W87-01207) (Khumbatta-PTT)
W87-01206

REGULATION AND SUBCELLULAR DISTRIBUTION OF COPPER IN THE FRESHWATER MOLLUSCS ANODONTA CYGNEA (L.) AND UNIO ELONGATULUS (PF.),
Padua Univ. (Italy). Dept. of Biology.
L. Tallandini, A. Cassini, N. Favero, and V. Albergoni.
Comparative Biochemistry and Physiology CBPCB5, Vol. 84C, No. 1, p 43-49, 1986. 4 fig, 2 tab, 41 ref. National Research Council (Italy) Grant 83.02.075.56 subproject 5, 0b 64; CEE ENV 568-I.

Descriptors: *Subcellular distribution, *Copper, *Freshwater molluscs, *Anodonta Cygnea, *Unio Elongatulus, Heavy metals, Toxicity, Bivalves.

Many organisms, particularly some marine bivalve molluscs, are able to accumulate high concentrations of copper, zinc, cadmium, manganese, etc. well above the environmental levels without suffering. The ability to survive severe metal exposure has been investigated in relation to the mechanisms involved in metal metabolism and particularly in relation to the role of metallothioneins (MTs). The effects of copper exposure were studied in two freshwater bivalves, Anodonta cygnea and Unio elongatulus. Copper exposure induces a small degree of copper accumulation in both organisms leading to the hypothesis of a regulatory mechanism for copper intake. Copper distribution in the particulate fractions is affected by copper treatments, with an increase in the lysosome-enriched fraction. Copper exposure does not affect zinc levels and distribution. The percentage distribution of copper and zinc among the cytosol fractions obtained from Sephadex G-75 varies with the organism, tissue and copper exposure suggesting that high molecular weight chelating compounds are actually present in the two organisms. (See also W87-01206) (Khumbatta-PTT)
W87-01207

TRACE METAL EXPORT IN URBAN RUNOFF AND ITS BIOLOGICAL SIGNIFICANCE,
Water Research Center, Canberra (Australia).
P. Liston, and W. Maher.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 900-905, June 1986. 1 fig, 2 tab, 19 ref.

Descriptors: *Trace metals, *Urban runoff, *Water pollution effects, *Aquatic environment, *Nonpoint pollution sources, Ecosystems, Water pollution sources, Sediments, Metals, Runoff, Streams, Tubificids, Aquatic animals, Oligochaetes.

Selected trace metals were measured in sediments of a stream draining an urban catchment to determine the relationship of trace metal concentrations in the sediment fractions to concentrations available for uptake by resident detritovores (tubificids). The trace metal concentrations in all interstitial waters were below detection limits (0.1 microgram per gram Zn, 0.5 microgram per gram Pb, and 0.2 microgram per gram Cu). Concentrations in sediments increased downstream in the urban catchment; levels were low in rural catchments. Trace metal concentrations at sites with more urban runoff were higher than those found in the sediments of some waterbodies with recognized point-source pollution, indicating that urban catchments may be significant non-point sources of trace metals to aquatic ecosystems. No relation could be established between trace metal concentrations in sediment fractions and accumulation by resident detritovores. (Doria-PTT)
W87-01219

BERYLLIUM IN SEDIMENTS OF NAGOYA HARBOR ESTUARIES,
Nagoya City Environmental Pollution Research Inst. (Japan).
For primary bibliographic entry see Field 5A.
W87-01225

RELEVANCE OF SCAVENGING KINETICS TO MODELING OF SEDIMENT-WATER INTERACTIONS IN NATURAL WATERS,
Lamont-Doherty Geological Observatory, Palisades, NY.
U. P. Nyffeler, P. H. Santschi, and Y.-H. Li.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 277-292, March 1986. 7 fig, 2 tab, 21 ref. NSF OCE 82-17248, OCE 81-11953, DEB 80-17639; NOAA NARAD-00016; DOE EYS02-2185.

Descriptors: *Path of pollutants, *Fate of pollutants, *Lakes, *Sorption kinetics, *Sediment-water interfaces, Shallow water, Model studies, Radioactive tracers, Tracers, Suspended solids, Metals.

The uptake of radioactive trace metals by suspended particles in natural aquatic systems is often slow and the time constants for scavenging are of the same order of magnitude as the residence times of particles in the water column. Therefore, models simulating removal of radioactive trace metals from water to sediments in shallow aquatic systems with short particle residence times need to include sorption (i.e., scavenging) kinetics. We present a numerical kinetic transport model designed to simulate tracer movements from a well mixed water

column where particles are generated by both primary production and sediment resuspension processes. Tracers are allowed to penetrate into underlying sediments by diffusion and particle and porewater mixing. All model parameters can be experimentally determined either in the ecosystem itself or in separate laboratory experiments. Model simulations of three kinds of experiments are presented: tracer diffusion in benthic flux chambers, and tracer removal in marine mesocosms and in lacustrine limnocorrals. Limited sensitivity analyses and simulations of actual experiments indicate that under conditions of particle cycling in the sediments and the water, tracer removal can be affected and--in the case of high particle fluxes, as in summer--even be limited by the slow kinetics of tracer uptake by suspended particles. The model is also useful in identifying and quantifying critical pathways in the complicated web of interrelated processes of an aquatic ecosystem. (Author's abstract)
W87-01228

METABOLIC ACTIVITIES IN FLOCCULENT SURFACE SEDIMENTS AND UNDERLYING SANDY LITTORAL SEDIMENTS,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
J. P. Sweerts, J. W. M. Rudd, and C. A. Kelly.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 330-338, March 1986. 5 fig, 7 tab, 21 ref. Canadian NSERC Grant A2671.

Descriptors: *Acid rain, *Lakes, *Water pollution effects, *Path of pollutants, *Fate of pollutants, *Organic matter, *Acidic water, Bottom sediments, Neutralization, Sulfuric acid, Sediment-water interfaces, Dissolved oxygen, Oxygen.

Parts of the sandy littoral sediment of an experimentally acidified Precambrian shield lake (Lake 302S) were intermittently covered with a layer of flocculent organic-rich material 1-20 mm thick. Sandy sediments with flocculent surface sediment had higher rates of respiration (31-105%) and photosynthesis (37-224%) than those without. Densities of invertebrate macrofauna were 10 times higher in the flocculent surface sediment than in the underlying sandy sediment, accounting for 17 vs. 5% of the total respiration. Microprofiles of oxygen concentration showed that almost all of the dissolved oxygen in the overlying water was consumed as it diffused through 5-7 mm of the flocculent surface sediment, so that the underlying sandy sediment was almost completely anaerobic in the presence of flocculent surface material. The presence of flocculent surface sediment also decreased the depth of penetration of sulfate into the sandy sediment since the zone of sulfate reduction was located closer to the sediment-water interface. In this experimentally acidified lake, neutralization of H_2SO_4 via sulfate reduction was more rapid (0.204 mmol H(+)/sq m/day) in the presence of surface flocculent sediment than in its absence (0.157 mmol H(+)/sq m/day). (Author's abstract)
W87-01230

REACTIVITY OF METALS FOR MARINE PHYTOPLANKTON,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
N. S. Fisher.
Limnology and Oceanography LIOCAH, Vol. 31, No. 2, p 443-449, March 1986. 1 fig, 1 tab, 45 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Metals, *Phytoplankton, *Bioaccumulation, Accumulation, Toxicity, Radioisotope studies, Algae, Marine algae, Heavy metals.

The concentration of metals by marine phytoplankton, assessed for diverse species in laboratory culture experiments with radiotracer methodology and taken together with literature values for other metals, was analyzed in light of geochemical models describing particle surface chemistry. Concentration factors vary among the metals from zero to about 1 million, and there are only modest differences (less than an order of magnitude) among algal species for any particular metal. Regression analyses show that, at equilibrium, the logs of the concentration factors are exponentially related ($P<0.001$) to solubility products of metal hydroxides and to cytotoxicity and are linearly related ($P<0.001$) to the log of the mean oceanic residence times (years) of the metals. It would appear that concentration factors and toxicity of metals in marine phytoplankton and oceanic residence times of metals can be predicted to within an order of magnitude from the chemical literature. (Author's abstract)
W87-01233

COMPARATIVE STUDY OF THE BIODEGRADATION OF THE SURFACTANT SODIUM DODECYLTRIETHOXY SULFATE BY FOUR DETERGENT-DEGRADING BACTERIA,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
S. G. Hales, G. K. Watson, K. S. Dodgson, and G. F. White.
Journal of General Microbiology JGMIAN, Vol. 132, No. 4, p 953-961, April 1986. 2 fig, 3 tab, 22 ref.

Descriptors: *Fate of pollutants, *Surfactants, *Biodegradation, *Sodium dodecyltriethoxysulfate, Bacteria, Degradation, Microbial degradation, Detergents.

The 35-S labelled metabolites produced during biodegradation of sodium dodecyltriethoxysulfate (SDTES) by four bacterial isolates were identified and quantified. The isolates, obtained from activated sludge, sewage outfalls, and a mixed sewage culture used ether-cleavage as the predominant primary degradation pathway. Two of the organisms liberated substantial portions of mono-, di-, and triethylene glycol monosulfates by the etherase system, responsible for 60-70% of primary degradation. The di- and tri-esters underwent some further oxidation to acetic acid 2-(ethoxy sulfate) and acetic acid 2-(diethoxy sulfate), respectively. These organisms also liberated sulfates (30-40%) directly from SDTES. Alkylsulfatases active toward SDTES were also found. Etherase action in the other two isolates was responsible for >80% of primary biodegradation, generating mainly triethylene glycol sulfate, which underwent some further oxidation. Very small amounts of diethylene glycol monosulfate were produced, but the monohomolog and oxidation products of these two esters were not present. Inorganic sulfate was liberated at about 10%. (Cassar-PTT)
W87-01238

METABOLITE PRODUCTION DURING THE BIODEGRADATION OF THE SURFACTANT SODIUM DODECYLTRIETHOXY SULPHATE UNDER MIXED-CULTURE DIE-AWAY CONDITIONS,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
E. T. Griffiths, S. G. Hales, N. J. Russell, G. K. Watson, and G. F. White.
Journal of General Microbiology JGMIAN, Vol. 132, No. 4, p 963-972, April 1986. 2 fig, 1 tab, 22 ref.

Descriptors: *Fate of pollutants, *Surfactants, *Biodegradation, *Sodium dodecyltriethoxysulfate, Degradation, Sewage bacteria, Sulfates, Bacteria, Detergents, Mineralization.

Sodium dodecyltriethoxysulfate (SDTES), either pure or as a component of commercial surfactant mixtures, underwent rapid primary biodegradation by mixed bacterial cultures in OECD (Organization for Economic Cooperation and Development) screen and river-water die-away tests. Inoculation of 35-S labelled SDTES-containing solutions with OECD screen test media acclimatized to surfactants or their degradation products led to production of various 35-S labelled glycol sulfates and their oxidation products, all known to occur during degradation of 35-S labelled SDTES by pure bacterial isolates. Triethylene glycol monosulfate was the major catabolite together with smaller amounts of di- and monoethylene glycol monosulfates implying by analogy with pure cultures, that ether-cleavage was the major primary biodegradation step. The oxidation product (carboxylate derivate) of each glycol sulfate was also detected together with metabolites tentatively identified as omega-/beta-oxidation products of the dodecyl chain. Relatively little sulfate was liberated directly from SDTES but mixed cultures derived from sewage could metabolize the sulfated glycols to sulfate. The environmental relevance of these degradation routes was established by following metabolite production from 35-S labelled SDTES in full-scale river-water die-away tests. Triethylene glycol sulfate was formed first, then rapidly oxidized to acetic acid 2-(diethoxy sulfate) which persisted as the major metabolite for 2-3 weeks. Small amounts of sulfated derivates of di- and monoethylene glycols were also detected during the same period. Very little sulfate was formed directly from SDTES but large amounts accompanied the eventual disappearance of glycol sulfate derivates. None of the 35-S labelled organic metabolites was persistent and, whenever 35-S labelled SDTES was a component of a commercial mixture, all ester sulfate was completely mineralized to 35-S labelled sulfate within 28 days. (Author's abstract)
W87-01239

TEMPORAL AND SPATIAL TRENDS IN METAL LOADINGS TO SEDIMENTS OF THE TURKEY LAKES, ONTARIO,
Department of Fisheries and Oceans, Owen Sound (Ontario). Great Lakes Fisheries Research Branch.
M. G. Johnson, L. R. Culp, and S. E. George.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 754-762, April 1986. 5 fig, 5 tab, 23 ref.

Descriptors: *Fate of pollutants, *Lakes, *Metals, *Sediments, Turkey Lakes, Ontario, Heavy metals, Aluminum, Iron, Manganese, Copper, Nickel, Zinc, Lead, Cadmium, Chromium, Mercury.

Sediment core profiles of metal concentration and 210-Pb activity were used to calculate metal loadings to five small Precambrian shield lakes of the Turkey Lakes system near Sault Ste. Marie, Ontario. Background levels of the metals were determined at pre-1900 sections of the sediment cores. Ratios of metal concentrations at the surface vs. background levels were as follows: Fe, 1.46; Mn, 1.48; zN, 1.76, Pb, 21.4; Cd, 2.81; and Hg, 2.72. Surface loading rates of Al, Cu, Ni, and Cr were not significantly greater than background rates. Fe and Mn were enriched in the surface sediment and downstream of the lakes. Pb, Cd, Hg, and Zn had significant anthropogenic inputs, averaging 18, 1.7, 1.4, and 0.6 times background loadings, respectively. Precipitation loadings of Pb and Hg were several times greater than background accumulation in lake sediments. Precipitation loadings of Cu, Ni, Zn, and Cd were the same order of magnitude as background inputs to sediments. (Cassar-PTT)
W87-01243

ACCUMULATION OF CADMIUM BY WHITE SUCKERS (CATOSTOMUS COMMERSONI) IN RELATION TO FISH GROWTH AND LAKE ACIDIFICATION,
Toronto Univ. (Ontario). Dept. of Zoology.
L. I. Bendell-Young, H. H. Harvey, and J. F. Young.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 806-811, April 1986. 3 fig, 3 tab, 27 ref.

Descriptors: *Fate of pollutants, *Acidic water, *Cadmium, *Fish, *Path of pollutants, *Acid rain, *Heavy metals, Metals, Lakes, Bioaccumulation, Accumulation, Suckers, White suckers, Ontario, George Lake, Red Chalk Lake, King Lake, McDonald Lake, Crosson Lake, Harp Lake, Growth rate.

Tissues of white suckers (Catostomus commersoni) from six lakes in Ontario were analyzed for cadmium content. These lakes ranged in pH from 4.8 to 6.4. Cd sediment concentrations at the surface-water interface (1 cm depth) of the six lakes ranged from 1.6 + or - 0.7 to 3.5 + or - 2 micrograms per g dry mass. Kidney tissue contained about 3 times

the Cd concentration as did liver tissue. Cd levels in liver tissue were 3.4 + or - 2.7 micrograms per g in the most acid lake; 0.4 + or - 0.2 to 4.7 + or - 4.0 micrograms per g in the other five lakes. A study of growth rates in the six lakes indicated that the accumulation of Cd by the sucker populations was proportional to the respective rates of fish growth. Fish from McDonald Lake, a small, shallow, highly organic acid lake, showed the lowest Cd accumulations in liver and kidney tissue. (Cassar-PTT)
W87-01246

TRANSPORT OF 60-CO BETWEEN WATER AND SEDIMENTS IN A SMALL SHIELD LAKE,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
R. J. Cornett, and I. L. Ophel.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 877-884, April 1986. 8 fig, 31 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Lakes, *Cobalt radioisotopes, *Radioactive waste, Bottom sediments, Lake sediments, Sediments, Model studies.

Low levels of 60-Co, discharged from a waste management area, have flowed into a small shield lake over a period of 22 yr. Constructing a mass balance using measured waterflows, measurements of 60-Co activities in the inflow, in the bottom sediments, and in the lake outlet provides a unique record of the isotope's behavior. The long-term, annual, and seasonal movements of 60-Co between the water, sediments, and the outflow have been examined and compared. An instantaneously mixed, single reservoir model with constant parameters accurately simulated the average annual variations in 60-Co activity in the water and in the sediments. The lake sediments were the major sink for 60-Co. More than 90% of the 60-Co present in the lake system at any one time was found in the sediments. However, less than half of the total 60-Co inputs were retained in the sediments over the 22-yr period. The remainder left the lake through the outflow. The fractional rate of 60-Co deposition in the sediments was independent of the rate of 60-Co inputs and independent of the 60-Co activity in the lake sediments. Seasonal changes in 60-Co concentrations in the lake water were very large. Spring and summer concentrations were often 50-500% lower than predicted from a model that simulated annual average concentrations. The bias was likely due to rapid removal of 60-Co by increased scavenging of the isotope by particulates. During the winter, 60-Co concentrations in the lake water were greater than expected, probably due to the exclusion of 60-Co from lake ice, incomplete mixing of the inflow with the lake water, or release of 60-Co from the sediments. These seasonal variations in the 60-Co activity were accurately simulated by a single reservoir model using different removal rates for the summer and winter periods. (Author's abstract)
W87-01249

DETECTION AND ENUMERATION OF LISTERIA MONOCYTOGENES IN A SEWAGE TREATMENT PLANT IN IRAQ,
Biological Research Center, Baghdad (Iraq).
M. R. Al-Ghazali, and S. K. Al-Azawi.
Journal of Applied Bacteriology JABAA4, Vol. 60, No. 3, p 251-254, March 1986. 2 tab, 17 ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Sludge, *Bacteria, Sewage bacteria, Listeria monocytogenes, Iraq, Land application.

Listeria monocytogenes was found in all stages of sewage treatment at a plant in Baghdad, Iraq. Listeria counts were obtained monthly for a year, starting in March 1984. Highest counts, other than incoming raw sewage were in raw sewage sludge. Digested sewage sludge contained up to 28 bacteria per g; sewage sludge cake, up to 15 organisms per g. The final effluent Listeria count was <3 to 39 per ml. Low numbers of Listeria recorded in sewage sludge cake during May-September (<3 per g) coincided with the low moisture content of the cake, less than 4% compared with 50-70% moisture during fall and winter. The survival of this organism during sewage treatment at this plant shows that sludge should be exposed to the sun for longer periods before applying it as a fertilizer to agricultural land. (Cassar-PTT)
W87-01251

BACTERIOPHAGES AND INDICATOR BACTERIA IN HUMAN AND ANIMAL FAECES,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, K. Furuse, and W. M. Hogeboom.
Journal of Applied Bacteriology JABAA4, Vol. 60, No. 3, p 255-262, March 1986. 1 fig, 3 tab, 20 ref.

Descriptors: *Water pollution sources, *Fate of pollutants, *Bacteria, *Indicators, *Wastewater analysis, *Bioindicators, Animal wastes, Bacteria, Bacteriophages, Coliforms, Feces, Pathogens.

In an attempt to explain the presence of F-specific (RNA) bacteriophages in wastewater, fecal material from humans and variety of animals was examined. The phages were detected in appreciable numbers only in feces from pegs, broiler chickens, sheep and calves but not from dogs, cows, horses, and humans. Parallel examinations for somatic coliphages, thermotolerant coliforms, fecal streptococci and spores of sulfite-reducing clostridia revealed the consistent presence of these organisms in all types of samples, albeit in variable numbers. The number of F-specific bacteriophages was related to the total number of somatic coliphages but phage counts were unrelated to bacterial counts. F-specific RNA phages were grouped by serotyping and all animal isolates were found to belong to either group I (MS2 subtype) or IV (four different subtypes). Among the group IV isolates, most belonged to well-known subtypes SP (24 isolates) or FI (18 isolates) but five isolates were related to phage ID2 and one isolate was a new subtype. In contrast with animal isolates, 19 isolates from hospital wastewater belonged to serogroups II or III. (Author's abstract)
W87-01252

VERTICAL DRIFT AND REACTION EFFECTS UPON CONTAMINANT DISPERSION IN PARALLEL SHEAR FLOWS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics JFLSA7, Vol. 165, p 425-444, April 1986. 8 fig, 20 ref, 2 append.

Descriptors: *Path of pollutants, *Contaminant distribution, *Radioactive waste, *Shear flow, *Flow, Mathematical studies, Absorption, Turbulent flow, Drift, Model studies, Bottom sediments, Sediments.

The effects of the initial discharge profile, vertical drift, and boundary absorption were incorporated into a Gaussian approximation for the two-dimensional contaminant distribution in a parallel shear flow. Exact and asymptotic expressions are derived for the centroid displacement, shear-dispersion coefficient, and variance. For a case of accidental release of high-level radioactive waste into the sea, the preferable location for discharge is close to the bed. In the first example, absorption of contaminants into the sediments was enhanced by discharging the waste close to the bed. The second example illustrated that the dilution was greatest near the bed for the rapidly sinking contaminants because shear flow was greatest near the bed. (Cassar-PTT)
W87-01257

EXPERIMENTAL AND NUMERICAL STUDY OF WATER AND SOLUTE INFILTRATION IN LAYERED POROUS MEDIA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Hydromechanik und Wasserwirtschaft.
For primary bibliographic entry see Field 2F.
W87-01262

STUDY ON SYNTHETIC SEDIMENTGRAPHS FOR UNGAGED WATERSHEDS,
Transviron, Inc., Lutherville, MD.
For primary bibliographic entry see Field 2J.
W87-01263

TRANSVERSE DISPERSION FROM AN ORIGINALLY SHARP FRESH-SALT INTERFACE CAUSED BY SHEAR FLOW,
Technische Hogeschool Delft (Netherlands).
For primary bibliographic entry see Field 2F.
W87-01264

EVALUATION OF FILAMENTOUS ALGAE AS BIOMONITORS OF METAL ACCUMULATION IN SOFTWATER LAKES: A MULTIVARIATE APPROACH,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5A.
W87-01290

MODEL FOR PREDICTING THE INFLUENCE OF SUSPENDED SEDIMENTS ON THE BIOAVAILABILITY OF NEUTRAL ORGANIC CHEMICALS IN THE WATER COMPARTMENT,
North Texas State Univ., Denton. Dept. of Biological Sciences.
C. A. Staples, K. L. Dickson, J. M. Rodgers, and F. Y. Saleh.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 417-428. 2 fig, 5 tab, 21 ref.

Descriptors: *Models, *Suspended solids, *Organic compounds, *Fate of pollutants, *Toxicity, Water pollution effects, Sorption, Suspended sediments, Bioassays, Model studies, Prediction, Sediments, Dieldrin, Aromatic compounds.

Site-specific water quality criteria may evolve from national water quality criteria based on site water characteristics. Suspended solids may be an important modifying parameter. A model is presented relating suspended solids characteristics (organic carbon content and suspended solids concentration) with a neutral organic chemical's sorption coefficient. Investigation of case studies with acenaphthene, dieldrin, and chrysene shows the dissolved and particulate-bound fractions (C sub d and C sub p) of total chemical concentration (C sub t) to be dependent upon these factors. The model may be used to predict C sub p and C sub d in site waters. The model shows that chemicals with low K sub p (partition coefficient) values in the presence of low suspended solids concentrations and organic matter are relatively unaffected by suspended solids. Conversely, chemicals with high K sub p values, high suspended solids concentrations, and organic matter would be primarily sorbed to suspended solids. (Author's abstract)
W87-01315

AQUATIC SAFETY ASSESSMENT OF CHEMICALS SORBED TO SEDIMENTS,
Monsanto Co., St. Louis, MO.
W. J. Adams, R. A. Kimerle, and R. G. Mosher.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 429-453. 1 fig, 9 tab, 21 ref.

Descriptors: *Sediments, *Chlorinated hydrocarbons, *Sorption, *Fate of pollutants, *Toxicity, Safety, Midges, Bioaccumulation, Water pollution effects, Bioassay, Ecological effects, Organic carbon, Assessment.

Studies to define the key route of exposure (interstitial water, water column water, sediment or food) were conducted with Kepone and the midge, Chironomus tentans, in partial life cycle static and flow-through tests. Endpoints measured were survival, growth, and bioaccumulation. The no-effect concentrations for midges exposed to Kepone in the water were >5.4<11.8 ppb. No effects were

observed when the midges were fed food containing up to 17900 ppb Kepone. In sediment exposure studies, the no-effect concentrations varied from 3000 to 36000 ppb depending upon the organic carbon content of the sediment. In all sediment exposure studies, water column concentrations were below the water exposure chronic effect levels (11.8 ppb), and effects were observed only when the sediment interstitial column concentrations exceeded the 11.8 ppb water column exposure chronic effect level. Calculation of bioaccumulation factors based on water column concentrations or sediment concentrations were highly variable. It was concluded that the key route of exposure of C. tentans to Kepone is from the interstitial water and/or the water at the sediment/water interface. Interpretation of aquatic hazard and calculation of safety factors for nonionic organic chemicals sorbed to sediments should be based on the concentration of the chemical in the sediment interstitial water, which is a function of the chemical's sediment partition coefficient concentration of chemical on the sediment, and the organic carbon content of the sediment. (Geiger-PTT)
W87-01316

ROLE OF SEDIMENT ORGANIC MATTER ON SORPTION-DESORPTION REACTIONS AND BIOAVAILABILITY OF MERCURY AND CADMIUM IN AN INTERTIDAL ECOSYSTEM,
Battelle New England Marine Research Lab., Duxbury, MA.
R. J. Breteler, and F. I. Saksa.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 454-468. 3 fig, 5 tab, 32 ref. Battelle Memorial Institute Contract B-1333-1411.

Descriptors: *Path of pollutants, *Sediments, *Organic matter, *Sorption, *Cadmium, *Mercury, *Mussels, Ecosystems, Intertidal areas, Toxicity, Water pollution effects, Fate of pollutants, Marine sediments, Heavy metals, Salt marshes, Models, Multiple regression analysis, Bioaccumulation, Adsorption.

The adsorption-desorption behavior and bioavailability of mercury and cadmium in a model salt marsh ecosystem have been investigated. Specimens of two species of filter-feeding mussels, Mytilus edulis and Modiolus demissus, were placed in large rectangular enclosures containing marsh peat previously equilibrated with a seawater solution of the metals. The tissue concentration was determined after 21 and 70 days. Correlation between the levels of these metals in mussel tissue and the following parameters were examined: percent total organic matter, sediment metal concentration, acid leachable metal concentration, and amounts of metal desorbed from the sediment. Multiple regression analysis indicated a strong dependence of sorption-desorption processes on sediment organic matter content for both metals. Uptake of mercury was found to depend primarily on the amounts of acid leachable metal and the amounts of metal desorbed from the sediment. Cadmium uptake depended primarily on percent total sedimentary organic matter and the amounts of metal desorbed. (Author's abstract)
W87-01317

EFFECT OF PHYSICOCHEMICAL FORM ON COPPER AVAILABILITY TO AQUATIC ORGANISMS,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-01318

BIOAVAILABILITY OF TRACE METALS IN NATURAL WATERS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
J. R. O'Donnel, B. M. Kaplan, and H. E. Allen.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 485-501. 2 fig, 2 tab, 75 ref.

Descriptors: *Metals, *Trace metals, *Sediments, *Path of pollutants, *Fate of pollutants, *Bioassays, Natural waters, Water quality, Toxicity, Adsorption, Aquatic animals, Water pollution effects.

The relation between water quality and the availability of metals to organisms is examined. Current data on the toxicity of metals to aquatic organisms show effect levels over many orders of magnitude of total metal concentrations. Thus it appears that the bioavailability of metals is not related to this parameter. Data is available which suggests that water quality standards for metals should be based on free metal ion, and metal levels in sediments should also be considered. Metal bound in specific sediment compartments or phases may be the toxic form. The chemistry and measurement of metal species should be used as the basis for reviewing bioassay results. Further research needs to be conducted to elucidate the portion of sediment-bound metal which is bioavailable. Problems in the interpretation of bioassay results for natural waters arise from the addition of metal in excess of the capacity of organic ligands for complexation and in not allowing reactions to attain equilibrium. It will be necessary to develop models that are capable of predicting metal speciation and the effect of various management practices on the speciation. (Geiger-PTT)
W87-01319

BIOLOGICAL DEGRADATION OF COMPLEX IRON CYANIDES IN NATURAL AQUATIC SYSTEMS,
Liesch (Bruce A.) Associates, Inc., Iowa City, IA.
K. L. Cherryholmes, W. J. Cornils, D. B. McDonald, and R. C. Splinter.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 502-511. 4 fig, 5 tab, 7 ref.

Descriptors: *Biodegradation, *Cyanide, *Toxicity, *Fate of pollutants, Fish, Hydrogen ion concentration, Microbial degradation, Bacteria, Pseudomonas, Escherichia coli.

The degradation of potassium hexacyanoferrate (III) in aqueous solutions by bacteria (Pseudomonas aeruginosa and Escherichia coli) was investigated in laboratory experiments conducted in light-protected reaction vessels. A 3293 mg/L solution of potassium hexacyanoferrate (III) was prepared with sterilized water inoculated with bacteria. Within 25 days, concentrations of free cyanide increased rapidly, reaching 1460 micrograms/L. In contrast, a sterile control solution exhibited a concentration of only 15 micrograms/L within the same period. Further evidence of the significance of bacteria in the degradation of the hexacyanoferrate (III) anion was evidenced in the second experiment, where a Bacto-Nutrient Broth solution was utilized to ensure the development of large bacterial populations. In this experiment, an even higher free cyanide concentration (3952 micrograms/L) was achieved within 25 days. In terms of aquatic toxicology and in the formulation of surface water quality standards, these findings are significant, since the maximum free cyanide concentration produced in the experiments was far in excess of the 200 to 250 micrograms/L LC50 values determined for most fish species. (Geiger-PTT)
W87-01320

METHOD FOR PREDICTING THE RATE OF ABIOTIC DEGRADATION OF ORGANIC CHEMICALS IN THE ENVIRONMENT, (EINE VORAUSSAGEMETHODE ZUM ABIOTISCHEN ABBAUVERHALTEN VON ORGANISCHEN CHEMIKALIEN IN DER UMWELT),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Radiochemie.
H. Guesten, and L. Klasinc.
Naturwissenschaften, Vol. 73, No. 3, p 129-135, March 1986. 3 fig, 2 tab, 21 ref.

Descriptors: *Water treatment, *Water quality management, *Path of pollutants, *Fate of pollutants, *Economic efficiency, *Ozonation, *Drinking Water, Toxins, Water pollution sources, Ionization potentials, Organic compounds, Bhopal, Radicals.

A statistically relevant correlation between the reaction rate coefficient for the OH radical reaction with organic compounds in the gas phase at 300 K, and the corresponding ionization energies allows a rapid prediction of the abiotic degradability of organic compounds in the troposphere. Similarly, from a linear correlation of the reaction rate constant of ozone with aromatic compounds in water with the corresponding ionization potentials, the abiotic lifetime of these aromatic compounds during the final stage of drinking water purification by ozonation can be estimated, which allows a more economical use of ozone. (Author's abstract)
W87-01334

CHLORINATED HYDROCARBONS IN THE ENVIRONMENT - OCCURRENCE IN WATER, (CHLOR-KOHLENWASSERSTOFFE IN DER UMWELT - VORKOMMEN IM WASSER),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Oekologie.
F. R. Atri.
Zeitschrift Wasser und Abwasser ZWABAQ, Vol. 18, No. 6, p 243, December 1985. 1 ref.

Descriptors: *Chlorinated hydrocarbons, *Organic compounds, *Drinking water, *Chemical analysis, Groundwater, Surface water, Rainwater, Wastewater, Dichloroethylene, Trichloroethylene, Perchloroethylene.

Literature data are reported on concentration ranges in surface waters, drinking water, rainwater and sewage water, for the following species: 1,1-dichloroethylene, trichloroethylene, and perchloroethylene. Proper evaluation of this data requires considering additional information such as physical-chemical properties, ecology, degradation, persistence, accumulation and, still further, the total production and the applications of these substances. (Author's abstract)
W87-01335

TITRATION OF AQUATIC HUMIC SUBSTANCES AND THEIR CALCIUM COMPLEXES WITH STRONG ACIDS AND BASES, (TITRATION ISOLIERTER AQUATISCHER HUMINSTOFFE UND IHRER CALCIUM-KOMPLEXE MIT STARKEN BASEN UND SAUREN),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
F. H. Frimmel, W. Hopp, and K. -E. Quentin.
Zeitschrift Wasser und Abwasser ZWABAQ, Vol. 18, No. 6, p 259-262, December 1985. 5 fig, 2 tab, 21 ref. Deutsche Forschungsgemeinschaft Bonn-Bad Godesberg Project No. Fr 536/5.

Descriptors: *Humic acids, *Decomposing organic matter, *Organic acids, *Hydrogen ion concentration, Phenols, Metal complexes, Chemical analysis, Cations, Organic carbon.

The acid-base function of aquatic humic substances (HUS) was determined by titration with 0.02 and 1 molar NaOH, and 1 molar HNO3. Experimental details are included. The differential titration curve shows two maxima due to the buffer capacity of the carboxylic and phenolic OH-groups (pK sub s ca. 4 and 10). The presence of Ca(2+) apparently increases the acidity of the HUS, and the hysteresis for the protonation-deprotonation. Acid functional groups were determined to be 10 to 20 mmol/g dissolved organic carbon for the carboxylic and for the phenolic groups with significant differences according to the origin of the HUS. Operationally defined Ca-complexation capacity was 0.3 to 0.9 mmol/g DOC. (Author's abstract)
W87-01339

DYNAMICAL INTERPRETATION OF THE HYDROLOGICAL AND ECOLOGICAL CONDITIONS LEADING TO NOCTILUCA RED TIDE, (INTERPRETATION DYNAMIQUE DES CONDITIONS HYDROLOGIQUES ET ECOLOGIQUES CONDUISANT AUX EAUX ROUGES A NOCTILUCA),
Centre d'Oceanologie de Marseille (France).
P. Laborde, J. -M. Peres, J. -C. Romano, and Y. de Souza-Lima.

Comptes Rendus de l'Academie des Sciences (Series 3) CHDDAT, Vol. 302, No. 6, p 197-199, February 14, 1986. 12 ref.

Descriptors: *Red tide, *Noctiluca, *Rhone river, *Algal blooms, *Algae, Neritic environments, Deltas, Plankton.

A massive bloom of Noctiluca was observed from June 12 to June 15, 1984 near the mouth of the Rhone. A dynamic interpretation of the phenomenon is based on literature data, as well as on data on the makeup of the plankton ecosystem during the years 1981 to 1984. The interpretation touches on the generation of the bloom, the mechanisms of its transport, and the ultimate fate, upon their joining the surface ecosystem, of Noctiluca swarms which reached densities of 1000 cells per liter or greater. (Airone-PTT)
W87-01342

NATURAL SINK FOR NITRATES TRANSPORTED BY GROUNDWATER: THE ALDER FOREST, (UNE STATION D'EPURATION NATURELLE DES NITRATES TRANSPORTES PAR LES NAPPES ALLUVIALES: L'AULNAIE GLUTINEUSE),
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
G. Pinay, and L. Labroue.
Comptes Rendus de l'Academie des Sciences (Series 3) CHDDAT, Vol. 302, No. 17, p 629-632, May 7, 1986. 2 fig, 1 tab, 10 ref.

Descriptors: *Nitrates, *Alder trees, *Denitrification, *Louge River, Agricultural chemicals, Groundwater, Riparian vegetation, Ions, Piezometry, Forests.

The decrease in nitrate ion concentration of groundwater below an alder forest and measurement of denitrification in situ show that this alluvial ecosystem acts as an efficient natural sink for nitrates. The findings emphasize the need for greater conservation of this type of riparian forest. The data result from monthly piezometric measurements at a site near the Louge River in France in 1985. (Airone-PTT)
W87-01343

DISSOLVED FULVIC ACIDS FROM THE NEAR CONTINENTAL SHELF. RELATION TO ESTUARIES, (LES ACIDES FULVIQUES DISSOUS DANS LES EAUX DU PROCHE PLATEAU CONTINENTAL. RELATION AVEC LA SITUATION ESTUAIRIENNE),
Bordeaux-1 Univ., Talence (France). Groupe d'Oceanographie Physicochimique.
For primary bibliographic entry see Field 2L.
W87-01345

CHARACTERIZATION OF THE DISPERSIVE PROPERTIES OF A POROUS MEDIUM BY EXPERIMENTAL MEASUREMENTS OF THE MIGRATION OF A SALINE TRACER, (CARACTERISATION DES PROPRIETES DISPERSIVES D'UN MILIEU POREUX PAR MESURES EXPERIMENTALES DE LA MIGRATION D'UN TRACEUR SALIN),
Ecole Polytechnique, Montreal (Quebec).
C. Marche, G. Leclerc, M. Gaudette, and D. Delmas.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 279-285, June 1985. 7 fig, 1 tab, 9 ref.

Descriptors: *Mathematical models, *Dispersion coefficient, *Tracers, *Model studies, *Porous media, *Groundwater, Limestone, Sodium chloride, Water quality, Autoanalyzers, Computers, Migration.

Groundwater quality management requires a good understanding of contaminant migration phenomena within porous media. A horizontal experimental tank (gross area 63 sq m) was built at Ecole Polytechnique de Montreal. A detailed description of the tank is included. An automatic data acquisition system, built around a Timex-Sinclair ZX81 microcomputer, monitors the migration of a saline tracer through 30 probes. The dispersive properties of a limestone aggregate are derived from the spatial and temporal distribution of tracer concentration. The following estimated values are achieved for the dispersion coefficient: .0085 sq m/sec (longitudinal dispersion) and .000015 sq m/sec (transverse). These are compared with values obtained in other studies. (Airone-PTT)
W87-01347

OUTBREAK OF LEGIONNAIRES' DISEASE FROM A COOLING WATER SYSTEM IN A POWER STATION,
Community Health Services, Lancaster (England).
For primary bibliographic entry see Field 5C.
W87-01348

PROBLEMS OF MODELING SEEPAGE AND MASS TRANSPORT FOR PURPOSES OF PROTECTING GROUNDWATERS FROM POLLUTION,
For primary bibliographic entry see Field 5G.
W87-01394

MERCURY LEVELS IN RAIN AND AIR AND THE SUBSEQUENT WASHOUT MECHANISM IN A CENTRAL ITALIAN REIGON,
R. Ferrara, B. Maserti, A. Petrosino, and R. Bargagli.
Atmospheric Environment ATENBP, Vol. 20, No. 1, p 125-128, January 1986. 2 fig, 2 tab, 15 ref.

Descriptors: *Mercury, *Rain, *Path of pollutants, *Washout, *Fallout, *Air, *Atmospheric washout, Atmosphere, Mediterranean, Cinnabar deposits, Vaporization, Radiometer, Conductivity, Atomic fluorescence spectrometer, Italy.

The efficiency of Hg removal from the atmosphere by rain is still being debated. Hg levels in the rain and in the air of a Mediterranean area have been determined appropriate for investigating the washout mechanism. Mercury concentrations in precipitation and in air collected in this area were in the range of 7.9-17.0 ng per liter and 5.7-20.2 ng per cubic m, respectively. These values are similar to those reported in the literature for other geographic locations. The time dependence of dissolved Hg concentration in rain is discussed to clarify the efficiency of the washout mechanism. Anthropogenic Hg emission and the vaporization from cinnabar deposits seem to influence Hg levels in the atmosphere only on a local scale. (Main-PTT)
W87-01423

DETERMINATION OF CHROMIUM IN TREATED CRAYFISH PROCAMBARUS CLARKII, BY ELECTROTHERMAL AAS: STUDY OF CHROMIUM ACCUMULATION IN DIFFERENT TISSUES,
Valencia Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W87-01425

LEVELS OF TRIARYL/ALKYL PHOSPHATES IN HUMAN ADIPOSE TISSUE FROM EASTERN ONTARIO,
Environmental Health Directorate, Ottawa (Ontario).
G. L. LeBel, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 41-46, July 1986. 1 fig, 3 tab, 11 ref.

Descriptors: *Triaryllkyl phosphates, *Human adipose tissue, *Ontario, Canada, Fire retardants, Gas chromatography, Water contamination, Drinking water.

Trialkyl-, tri(haloalkyl)- and triaryl phosphate esters (TAAP's) are used as fire retardants. TAAP's have been found in Canadian drinking water supplies and fish. A method was developed for the determination of TAAP's in human adipose tissues. Tissue samples from cadavers were taken and adipose tissue was extracted. The extract was centrifuged, filtered through anhydrous sodium sulfate, and evaporated. The TAAP's were separated from the fat by gel permeation chromatography. The extracts were analyzed on a gas chromatograph. Positive identification was done by selected ion monitoring of at least four characteristic ions. The mean percent extracted fat for all the tissue samples was 71%. Tributoxyethyl phosphate (TBEP) and tris (1,3-dichloropropyl) phosphate (TRIS) were the main TAAP'S found in human adipose tissue. Some fat samples were found to contain high concentrations of both TBEP and TRIS. (Main-PTT)
W87-01431

ACCLIMATION TO SUBLETHAL ACIDIC AND ALKALINE MEDIA OF TILAPIA MOSSAMBICA (PETERS): CHANGES IN GLYCOGEN METABOLISM OF RED MUSCLE,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
M Bhaskar, and S. Govindappa.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 113-119, July 1986. 3 fig, 3 tab, 12 ref.

Descriptors: *Acid rain, *Water pollution effects, *Glycogen metabolism, Tilapia mossambica, Chemical analysis, Freshwater, Acidification, Toxicity, Fish.

Freshwater bodies are undergoing progressive acidification due to acid precipitation and acid mine drainage. A study dealing with the biological impact of acidity and alkalinity on the physiology and biochemistry of freshwater fish was undertaken. Tilapia mossambica were acclimatized to the laboratory and then divided into three groups. One group was a control, one was acclimated to acidic medium, and the third was acclimated to alkaline medium. Red muscle tissues were isolated after 15 days. Free glucose, lactic acid and pyruvic acid were estimated. Activities of phosphorylase a and ab were estimated in the direction of glycogen synthesis. Protein content and aldolase activity was estimated, and the activity level of glucose 6-phosphate dehydrogenase was determined. The activity levels of lactate dehydrogenase and malate dehydrogenase were estimated. Succinate dehydrogenase was estimated. In fish exposed to acidic medium, the red muscle had higher elevated glycogen content than the control. The activity levels of phosphorylase were inhibited, and free glucose was depleted more than on the normal fish. Despite higher aldolase activity the levels of both pyruvic and lactic acids were depleted. G-6-PDH activity was significantly elevated. In contrast, the red muscle reflects reverse pattern of metabolic events in response to acclimation of fishes to basic medium. (Main-PTT)
W87-01433

BIOACCUMULATION OF FOSSIL FUEL COMPONENTS DURING SINGLE-COMPOUND AND COMPLEX-MIXTURE EXPOSURES OF DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA.
D. D. Dauble, D. W. Carlile, and R. W. Hanf, Jr.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 125-132, July 1986. 1 fig, 2 tab, 16 ref. DOE Contract DE-AC06-76RLO.

Descriptors: *Bioaccumulation, *Fossil fuel, *Daphnia magna, Radiolabeling, Coal liquid, Phenol, Aniline, Kinetic models, Liquid scintillation spectrometry, Tissue analysis.

Tests with the water flea (Daphnia magna) compared the bioaccumulation of compounds presented alone or with the bioaccumulation of these same coupounds when they were in a complex coal liquid, water-soluble fraction. Phenol and aniline were used as representative compounds. Five daphnids from each treatment were removed for uptake counts after 1, 2, 4, 8, 16, and 24 hrs of exposure. Remaining daphnids were transferred to fresh water at 24 hours and removed for depuration counts at 25, 26, 32, 40, and 48 hrs. The water-soluble fraction (WSF) was chemically character-

ized for overall composition, and phenolics were found to comprise about 90% of the total carbon (TOC). Test organism in the single-compound-plus-WSF treatment were exposed to nominal concentrations of 0.5 mg/L TOC. All concentrations values reported during testing are based on measured radioactivity. Water samples were collected at various intervals and diluted with PCS scintillation fluid and counted with scintillation spectrometry. Five daphnids were removed by pipette at each sample interval for tissue analysis. Kinetic model theory and nonlinear least square techniques were used to obtain estimates of uptake and depuration rates and bioconcentration factors. Independent estimates of depuration rates from the depuration phase data were used to estimate BCFs and 14C half-life values. Mean 14C concentrations in water after 24 hours depuration were less than 2 micro g/L for the phenol only and phenol-plus-WSF. BCFs estimated from 14C activity and using dry-weight conversions were 1,375 and 876 for phenol-only and phenol-plus-WSF exposures, respectively. Significant differences were detected in the uptake rate constants of parent compound plus metabolite betweeen the single-compound and compound-plus-WSF exposures. There was no significant difference in either the uptake or depuration rate constants between aniline-only and aniline-plus-WSF treatments. The difference in observed BCFs may be attributable to the chemical composition of the WSF. Main-PTT)
W87-01434

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS FROM THE SAGUENAY FJORD, CANADA,
Institut National de la Recherche Scientifique, Montreal (Quebec).
L. Martel, M. J. Gagnon, R. Masse, A. Leclerc, and L. Tremblay.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 133-140, 1986. 5 fig, 2 tab, 8 ref. NSERC (Canada) Grant A-2629.

Descriptors: *Polycyclic aromatic hydrocarbons, *Path of pollutants, *Sediments, *Saguenay Fjord, *Fate of pollutants, Canada, Aluminum smelting, PAH distribution, Chromatography, Gas chromatography.

The spatial distribution of PAH concentrations in the Saguenay Fjord surface sediments was determined and the behavior of these compounds in this environment was studied. Surface sediment was collected at stations along the Fjord. The sediment was fortified with two internal standards and extracted with dichloromethane for 15 h. The extracts were concentrated and applied to copper, silica gel, and alumina chromatography columns. The PAH containing fractions were analysed by capillary column gas chromatography. The chromatographic data indicate that the levels of alkylated homologs of PAH were relatively low as opposed to that of unsubstituted PAH. The ratios of alkylated/nonalkylated PAH were relatively constant throughout the sediment samples. Distribution of PAH in the Saguenay Fjord showed that the concentrations of PAH were maximum near the aluminium smelting plants located in the Chicoutimi area and decrease with distance from this industrial zone. Qualitatively the PAH profiles are similar from one sediment sample to another. The nature of the PAH found in the sediment of the Fjord is suggestive of localized and anthropogenic inputs. The mean level of contamination is relatively high in this environment. (Main-PTT)
W87-01435

TRACE METAL RESIDUES IN BIOTA AND SEDIMENTS FROM LAKE PONTCHARTRAIN, LOUISIANA,
New Orleans Univ., LA. Center for Bio-Organic Studies.
C. J. Byrne, and I. R. DeLeon.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 151-158, July 1986. 4 tab, 17 ref. Army Corps of Engineers Contract DACW29-82-M-0189.

Descriptors: *Trace metals, *Path of pollutants, *Biota, *Sediments, *Lake Pontchartrain, Oysters, Clams, Arsenic, Beryllium, Copper, Cadmium, Lead, Mercury, Nickel, Thallium, Selenium, Chromium, Silver, Zinc, Atomic absorption spectrophotometry.

Baseline values of arsenic, beryllium, copper, cadmium, lead, mercury, nickel, thallium, selenium, chromium, silver, and zinc in indigenous biota and sediment from three passes of Lake Pontchartrain were established. Samples of oysters, clams, and surface sediments were collected. Tissue sample were processed either by the procedure of Rogerson and Galloway or by the procedure of Martin and Knauer and EPA. The former were analyzed by graphite furnace atomic absorption spectrophotometry (GFAAS) and the latter by gas hydride atomic absorption sepctrophotometry (GHAAS). Sediment samples were processed by the method of Eisler and subsequently analyzed by FAAS/GFAAS. For the determination of arsenic, mercury, and selenium, the sediment samples were processed as follows. A 50% solution of nitric acid was added to the sample and 5 ml of 5% potassium permanganate was further added. The solution was heated and hydrogen peroxide was added. The solution was filtered and sodium chloride-hyroxylamine hydrochloride solution was added. This sample was analyzed by GHAAS. The final sample solutions were analyzed by flame or flameless graphite furnace AAS on an atomic absorption spectorphotometer. Of the 12 metals tested, only thallium was not observed in tissue samples. Oysters collected at the IHNC contained extremely high concentrations of zinc, whereas the clams from the other two passes contained higher concentrations of copper. Oysters from IHNC possesed higher concentations of lead, cadmium, and mercury than the clams. Comparison of the levels of heavy metals in the biota and surface sediment of other Gulf Coast estuaries revealed similar concentrations. (Main-PTT)
W87-01437

ARGONNE'S ACID RAIN STRATEGY VS. S. 3041,
B. J. Spalding.
Chemical Week, Vol. 138, No. 21, p 32, 37, May 1986.

Descriptors: *Argonne National Laboratory, *Acid rain, *Sulfur deposition, *National Acid Precipitation Assessment Program, Legislation, Economics, Adirondack mountains, Canada, Mathematical models.

Argonne National Laboratory proposes to cut sulfur deposition in sensitive areas, and the cost would be 1 billion dollars per year, about one-fourth as much as proposed legislation allows for. The key to Argonne's approach is its atmospheric transport model - Advanced Statistical Trajectory Regional Air Pollution. It predicts the relationship among emissions, deposition, and meteorology. Also important to the Argonne concept are data on the cost and performance of pollution control technology and the costs of various coals. Upon testing the strategy attained similar reductions in sulfur deposition in the Northeast 'signigicantly' cheaper than under the proposed law. An 'unavoidable degree of uncertainty' is inherent in an atmospheric transport model; yet, such models can be useful. The National Acid Precipitation Assessment Program is developing a more comprehensive model - the Regional Acid Deposition Model - that will include more understanding of atmospheric processes and will simulate the behavior of multiple pollutants in three dimensions. (Main-PTT)
W87-01439

CASE STUDY OF A CHEMICAL SPILL: POLYCHLORINATED BIPHENYLS (PCBS), 3. PCB SORPTION AND RETARDATION IN SOIL UNDERLYING THE SITE,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
M. R. Anderson, and J. F. Pankow.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1051-1057, July 1986. 2 fig, 4 tab, 27 ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Chemical wastes, *Sorption, *Groundwater pollution, Soil contamination, Chemical analysis, Soil sampling, Regina aquifer, Aquifers, Benzene.

Condie silt from near a polychlorinated biphenyls (PCBs) and chlorinated benzenes spill site was studied with respect to the sorption and predicted retardation of these compounds. The soil organic carbon fraction of the silt was measured to be 0.0036 + or - 0.00088. The sorption partition coefficient (K sub p, ml/gm) values were: 4-PCB, 5000; 5-PCB, 9400; and 6-PCB, 26,000. The direct measurement of the K sub p values allowed an improved estimation of sorption over that possible with the measured f sub oc and the available literature K sub oc data. Mean transport retardation factors(R) for 4-PCB, 5-PCB, and 6-PCB in saturated silt were calculated to be 2.7 E + 0.4, 5.0 E + 04, and 1.4 E + 05, respectively. This implies that dissolved PCBs will move only very slowly through unfractured Condie silt. Since the K sub p values of the PCBs were not affected when 20 mg/L of 1,2,4-trichlorobenzene was added to the aqueous phase, PCB transport at the site will not be accelerated by the presence of the chlorinated benzenes. Therefore if fractures are not present in the silt in its middle and lower levels, then there is little chance that the PCBs pose a threat to the underlying Regina aquifer system. R values predicted for 1,2,4-trichlorobenzene and 1,2,4,5-tetrachlorobenzene were 120 and 600, respectively. They may also not pose an immediate threat to the underlying aquifer if fractures are absent. (Author's abstract)
W87-01444

STEADY INFILTRATION FROM BURIED DISCS AND OTHER SOURCES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1058-1066, July 1986. 2 fig, 3 tab, 26 ref.

Descriptors: *Infiltration, *Groundwater movement, *Path of pollutants, *Buried discs, *Water pollution sources, Analog models, Waves, Graphical analysis, Capillary conductivity, Capillarity, Hydraulic conductivity, Soil contamination.

Scattering analog techniques were used to analyze steady quasilinear infiltration from buried discs and to develop related results. The exact solution involves spheroidal wave functions but, more usefully, expresses the far-field wetting function and the discharge function as expansion appropriate for small and large values of s, the dimensionless disc radius. Other simple techniques for estimating the moisture field include boundary layer and Green's function methods. Further aspects of the study include: useful comparisons with Wooding's classical results for the surface disc, and small s expansions, not hitherto available, for steady infiltration from cylindrical and spherical cavities. Buried discs (with aspect ratio h = 0), oblate spheroids (0 < h < 1), spheres (h = 1), and prolate spheres (h > 1) form an ordered sequence. Both capillary effects and the difficulty of matching small and large s expansions increase markedly with h. The surface disc is an exceptional 'least capillarity' case. The foregoing considerations lead to design principles for permeameters to measure the saturated hydraulic conductivity of unsaturated field soils. The customary borehole permeameter has h large and consequently strong capillary effects. But saturated conductivity has greatest influence on permeameter discharge when capillary effects are least. Accordingly, the optimal design is the surface disc permeameter, with h = 0 and minimal capillary effects. (Author's abstract)
W87-01445

ROLE OF GROUNDWATER IN DELAYING LAKE ACIDIFICATION,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson, and C. J. Bowser.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1101-1108, July 1986. 7 fig, 3 tab, 39 ref.

NSF Contract No. DEB 8012313.

Descriptors: *Lakes, *Acid rain, *Groundwater, *Model studies, Acidic water, Water quality control, Hydrogen ion concentration, Wisconsin, Simulation analysis, Chemical analysis, Chemical reactions.

The role of groundwater systems in delaying lake acidification was studied using a deterministic approach. Specifically, an advection-dispersion model of the groundwater system was linked to a simple groundwater-rain-lake mixing model, which in turn was linked to a geochemical speciation and reaction path model. Simulations of hypothetical groundwater-lake systems utilized chemical data from small lake systems in northern Wisconsin, an area which is currently experiencing acid rain (pH = 4.6) and is potentially sensitive to acid rain impacts owing to the absence of carbonate minerals in the underlying glacial tills and bedrock. Results of the modeling studies demonstrated that even when the effects of chemical reactions are ignored, groundwater inflow can mitigate the effects of acid deposition on lakes. When chemical reactions in the groundwater system were included in the model using a retardation factor, the acidification rate of the lake was significantly decreased. When speciation reactions between lake water and net acid additions were simulated using the geochemical model PHREEQE, the depression of lake water pH was markedly reduced, indicating that low alkalinity lakes, like the ones in northern Wisconsin, may have appreciable buffering capacity. (Lantz-PTT)
W87-01450

FREQUENCY DOMAIN ANALYSIS OF GROUNDWATER QUALITY FLUCTUATIONS: INTERPRETATION OF FIELD DATA,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
C. J. Duffy, and L. W. Gelhar.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1115-1128, July 1986. 15 fig, 22 ref. NSF Grant CEE83-07982.

Descriptors: *Groundwater quality, *Mathematical analysis, *Frequency domain analysis, *Tracers, *Spectral analysis, *Path of pollutants, *Groundwater movement, Frequency analysis, Mathematical studies, Geohydrology, Data interpretation, Field tests.

Spectral analysis and frequency domain methods were applied to temporal tracer patterns for the physical interpretation of transient environmental tracers in a variety of hydrologic settings. Three case studies were examined where the source of environmental tracer is represented as a stochastic process. Spectral analysis was used to identify the frequency domain structure of the field data, and linear filters were constructed using solutions to stochastic differential equations to model the observed response. An important general feature of the results is that different source configurations (e.g., nonpoint, line, or plane sources) and different groundwater flow field (uniform, nonuniform) produce distinctive frequency response characteristics for tracers in each system. In each case the unique filtering pattern is associated with physical properties of the hydrogeologic system and is shown to be useful for parameter estimation (response time, velocity, dispersivity, transmissivity, etc.). Although there could be some argument as to the specific form of the filter chosen, the theoretical result was consistent with the observed frequency characteristics of the field data in each case. The methodology provides a new tool for interpretation of transient environmental tracers subject to 'natural' time variations of the source strength. (Lantz-PTT)
W87-01452

THREE-DIMENSIONAL SOLUTIONS FOR SOLUTE TRANSPORT IN AN INFINITE MEDIUM WITH MOBILE AND IMMOBILE ZONES,
Stanford Univ., CA. Dept. of Civil Engineering.
M. N. Goltz, and P. V. Roberts.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1139-1148, July 1986. 6 fig, 28 ref, 2 append. EPA Agreement R 808851.

Descriptors: *Solute transport, *Infinite media, *Porous media, *Path of pollutants, Mathematical equations, LaPlace equation, Fourier analysis, Mathematical models, Sorption, Aquifers.

Tailing of breakthrough responses, which has been experimentally observed during flow through porous media, can be modeled by dividing the porous medium into regions of mobile and immobile water, and coupling the advective-dispersive solute transport equation with expressions to describe diffusional transfer between the two regions. Three-dimensional solutions to this coupled set of partial differential equations with infinite boundary conditions are derived by applying the LaPlace transform to the equations with respect to time, and the Fourier transform with respect to space. Sorption is presumed to be governed by a linear equilibrium relation, and deviations from equilibrium are accounted for by including expressions for solute transfer between mobile and immobile regions. Solutions are given for point sources. Superposition may be used to derive solutions for more complex initial conditions. The solutions for semi-infinite and infinite media are similar at large values of the Peclet number. This is convenient, as the infinite solution is simpler and obtained more straightforwardly than the semi-infinite solution. The solutions presented here may be useful for interpreting observations of solute transport in aquifers. (Lantz-PTT)
W87-01454

PROBLEM OF COMPLEX EIGENSYSTEMS IN THE SEMIANALYTICAL SOLUTION FOR ADVANCEMENT OF TIME IN SOLUTE TRANSPORT SIMULATIONS: A NEW METHOD USING REAL ARITHMETIC,
Geological Survey, Albuquerque, NM.
A. M. J. Umari, and S. M. Gorelick.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1149-1154, July 1986. 6 fig, 1 tab, 13 ref.

Descriptors: *Eigensystems, *Solute transport, *Simulation analysis, *Path of pollutants, Mathematical analysis, Mathematical studies, Dispersivity.

A new method is given for the representation of a complex eigensystem by use of real arithmetic in the semianalytical advancement of time for solute transport numerical simulations. A numerical example is presented that and it demonstrates the following points: (1) The time-discretized solution converges to the given semianalytical solution. This is in keeping with theory and demonstrates that the semianalytical solution is formulated correctly; (2) For large values of dispersivity, the number of imaginary eigenvalues of (M) is small. Incorrect representation by ignoring their imaginary parts has a minimal effect on the solutions. Conversely, for small values of dispersivity, the number of imaginary eigenvalues is large. Incorrect representation by ignoring their imaginary parts substantially affects the solution; and (3) For a particular physically realistic value of dispersivity alpha sub L that may be used, the relative dispersivity alpha sub L/L sub max can be small unless L sub max is made small by resorting to costly fine spatial discretization. In cases where the relative dispersivity is small, it is important not to ignore the imaginary components of the complex eigenvalues. The method presented here using real arithmetic has been shown to do that accurately. (Lantz-PTT)
W87-01455

ENZYMATIC HYDROLYSIS OF PROTEINACEOUS PARTICULATE AND DISSOLVED MATERIAL IN AN EUTROPHIC LAKE,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
G. Z. Halemejko, and R. J. Chrost.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 1, p 1-21, July 1986. 14 fig, 42 ref.

Descriptors: *Enzymes, *Path of pollutants, *Fate of pollutants, *Detritus, *Hydrolysis, *Eutrophic lakes, Organic matter, Diurnal distribution, Proteins, Decomposition, Chemical reactions, Leucine, Eutrophication, Albumin, Lakes.

Detrital proteolytic rates, the kinetics of aminopeptidase and endopeptidase activities in the photic and profundal zones of an eutrophic lake were studied in relation to the decomposition of particulate and dissolved proteinaceous matter. Significant activities of proteolytic enzymes were observed. Vertical measurements of proteolysis of particulate proteinaceous matter in the water column of the lake showed that decomposition processes were much faster in the epilimnion than in the profoundal zone. Highest detrital proteolysis and aminopeptidase activity rates were found after breaking down of the spring and summer phytoplankton blooms. In studies on the mechanisms involved with enzyme activity regulations in lake water, the influence of leucine and protein on the kinetics of aminopeptidase and endopeptidase were tested. Leucine was the competitive inhibitor of aminopeptidase activity. Increased concentrations of albumin inhibited both aminopeptidase and endopeptidase activities and decreased the enzyme affinities. Albumin was an uncompetitive inhibitor of endopeptidase. The data showed that proteolytic activity in the lake can be regulated by complex biological and environmental factors. Both aminopeptidase and endopeptidase activities varied strongly in the surface waters of the lake and indicated a diurnal cycle. Aminopeptidase activity increased from noon until sunset, decreased strongly during the night and was inversely proportional to dissolved protein concentrations. Endopeptidase activity was the highest at noon and at midnight and was proportional to total protein concentrations. The ecological significance of the enzymatic decomposition of proteinaceous matter in the lake is discussed. (Lantz-PTT)
W87-01456

UREA METABOLISM AND ITS SIGNIFICANCE IN THE NITROGEN CYCLE IN THE EUPHOTIC LAYER OF LAKE BIWA: I. IN SITU MEASUREMENT OF NITROGEN ASSIMILATION AND UREA DECOMPOSITION,
Osaka Kyoiku Univ. (Japan). Lab. of Environonmental Science and Education.
For primary bibliographic entry see Field 2H.
W87-01457

SURVEY OF VOLATILE HALOGENATED ORGANICS (VHO) IN ITALY: LEVELS OF VHO IN DRINKING WATERS, SURFACE WATERS AND SWIMMING POOLS,
Modena Univ. (Italy). Ist. di Igiene.
G. Aggazzotti, and G. Predieri.
Water Research WATRAG, Vol. 20, No. 8, p 959-963, August 1986. 8 tab, 34 ref.

Descriptors: *Volatile organics, *Water pollution sources, *Italy, *Trihalomethanes, *Drinking water, *Surface water, *Swimming pools, Water quality, Chlorine, Sodium hypochlorite, Water pollution, Chlorinated hydrocarbons, Pollutant identification.

A survey undertaken in Italy (Emilia-Romagna region) showed that volatile halogenated organics (VHO) are present in many water samples. Analysis was performed by static head-space gas chromatographic techniques. In drinking water samples, low levels of pollution were evident before any treatment, while after chlorination with sodium hypochlorite, or chlorine as a gas, VHO appeared, almost exclusively as trihalomethanes (THM), sometimes at fairly high levels (max = 41.8 micrograms/L). Surface water samples were collected every other month in one year, and had different levels of contamination. In most cases VHO (mainly chlorinated solvents) appeared just as traces, seldom at high concentration (max = 263 micrograms/L). Swimming pool samples had high levels of contamination (max = 177.4 micrograms/L), mainly due to THM, as a consequence of chlorination with sodium hypochlorite. VHO pollution is wide-spread in every kind of water. While contamination of surface waters can only involve environmental and aquatic life, contamination of

drinking waters, and also of swimming pool waters must be controlled as it can directly act on human health. (Author's abstract)
W87-01463

CHANGES OF TRIHALOMETHANE FORMATION POTENTIALS IN THE TONE RIVER,
Gunma Inst. of Public Health (Japan).
M. Uchiyama, Y. Nakajima, and Y. Magara.
Water Research WATRAG, Vol. 20, No. 8, p 999-1003, August 1986. 10 fig, 8 ref.

Descriptors: *Trihalomethane, *Tone River, *Path of pollutants, *Water pollution effects, *Japan, Streams, Rivers, Pollution load.

The changes of trihalomethane formation potentials (THMFPs) in the Tone River in Japan were examined. There were clear differences not in THMFPs but in THMFP loadings (THMFP x flow rate) in the winter and the summer. There was a strong correlation between watershed area and THMFP loading. The THMFP loading ratio caused by artificial pollution was sharply increased and reached 80% for a watershed area of 2,000sq km (with a population density of 65 persons/sq km). There was a strong correlation between population density and THMFP and THMFP loading. From these relationships, two formulas were developed to estimate the THMFP and the THMFP loading of the Tone River in the future. (Lantz-PTT)
W87-01468

GROWTH CHARACTERISTICS OF AEROMONAS HYDROPHILA IN LIMNETIC WATERS OF VARYING TROPHIC STATE,
Rhode Island Univ., Kingston. Dept. of Microbiology.
S. R. Rippey, and V. J. Cabelli.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 311-319, July 1985. 3 fig, 2 tab, 7 ref. EPA Grant No. R807252.

Descriptors: *Aeromonas hydrophila, *Growth kinetics, *Limnology, Trophic level, Bioindicators, Water pollution, Phosphorus, Lakes, Ponds, Nutrients.

The growth kinetics of Aeromonas hydrophila in waters of varying nutrient enrichment were examined to assess their potential as indicators of the trophic state of fresh waters, and as predictors of changes in limnetic water quality. Growth of the organism generally did not occur in untreated waters held at 22 C. Rapid growth of the organism did occur in filtered-autoclaved fresh waters and high maximal stationary phase densities resulted. Among 18 lakes and ponds examined, the generation times of the organism were well correlated with total phosphorus levels and Secchi depth, and with an index proposed for use in trophic state assessments. Maximal stationary phase densities generally showed lesser correlation with individual trophic state parameters and the index. The generation times of the bacterium, in lake and pond waters variously modified to encompass a range of nutrient levels, indicate that this growth parameter may be a very sensitive predictor of the eutrophication process. (Author's abstract)
W87-01482

DETERMINISTIC MODELING OF DISPERSION IN HETEROGENEOUS PERMEABLE MEDIA,
South Dakota School of Mines and Technology, Rapid City. Dept. of Geology and Geological Engineering.
A. D. Davis.
Ground Water GRWAAP, Vol. 24, No. 5, p 609-615, September-October, 1986. 8 fig, 17 ref.

Descriptors: *Path of pollutants, *Model studies, *Heterogeneous media, *Permeability, Groundwater pollution, Groundwater movement, Solute transport, Aquifers, Alluvial aquifers, Simulation analysis.

Numerical experiments show that variations of an order of magnitude in transmissivity or hydraulic conductivity can cause significant dispersion even when relatively small values of dispersivity are assumed. Such variations should be represented in a deterministic model of solute transport in order to describe the flow field adequately and to simulate dispersion realistically. In an example of a field application to an alluvial aquifer, a satisfactory match to observed field data was obtained using a small (0.01 m) value of longitudinal dispersivity and a grid spacing fine enough to show field-scale alluvial heterogeneities. When large (approximately 30 m) values of longitudinal dispersivity were used, computed solute concentrations were about half of observed values in parts of the aquifer. Modeling efforts with grid spacings two to six times wider than alluvial channels in the aquifer, produced groundwater flow and solute-transport simulations which did not adequately match field data. (Author's abstract)
W87-01492

MATHEMATICAL MODELING OF TOXICITY PROBLEMS IN AQUARIA,
Johns Hopkins Univ., Baltimore, MD. School of Medicine.
M. K. Stoskopf.
Journal of Environmental Pathology, Toxicology, and Oncology JEPOEC, Vol. 6, No. 3/4, p 351-360, March-April 1986. 3 fig, 3 ref.

Descriptors: *Mathematical models, *Toxicity, *Aquaria, Toxicokinetics, Mathematical studies, Poisons, Bioassay, Fish toxins.

To identify an actual or potential toxicity problem in an aquatic system, several questions are to be answered. The points to be kept in mind are; Is the toxic agent still being added to the system. Where is the toxin coming from. Are the current filtration systems removing it. How soon can it be reduced to an acceptable level. How can it be removed faster. These questions in turn suggest an equally important question. What samples should be examined. Analysis of animal tissues from bioassays is the most common investigative technique in use, but alternatives do exist. Testing of water has not been utilized to its fullest potential. The need for an orderly approach to sampling and interpretation has been a major factor in this under utilization. Mathematical modeling through the use of toxicokinetics can be used to maximize the efficiency of analysis of a toxic accident by water sampling. Strategies of sampling and interpretation of results arediscussed using the tools of toxicokinetic modeling. (Author's abstract)
W87-01500

NATIONAL ACADEMY OF SCIENCES REPORT. ACID DEPOSITION: TRENDS, RELATIONSHIPS, AND EFFECTS,
Pennsylvania Univ., Philadelphia.
For primary bibliographic entry see Field 5C.
W87-01504

INTEGRATED APPROACH TO ASSESSING ACID DEPOSITION,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 5C.
W87-01505

PATTERNS OF POLLUTION IN THE HUDSON-RARITAN BASIN,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Engineering and Public Policy.
R. U. Ayres, and S. R. Rod.
Environment ENVTAR, Vol. 28, No. 4, p 14-18, 20, 39-43, May 1986. 8 fig, 5 tab, 21 ref.

Descriptors: *Water pollution control, *Path of pollutants, *Water pollution sources, *Hudson-Raritan basin, *Water pollution, *Pollution patterns, Stream pollution, River basins, Contaminants, Pollution studies.

Slow but steady progress is being made in cleaning up the rivers and coastal waters of the Hudson-Raritan basin. Many practical and policy-relevant questions concerning the anticipated benefits for the basin of physical and institutional actions, past and ongoing, arise. The major contaminants studied fell into three categories of materials thought to pose the greatest present threat to the ecosystem or to humans. These were heavy metals such as arsenic, cadmium, chromium, copper etc, pesticides and herbicides and other critical pollutants and PCBs, polynuclear aromatic hydrocarbons, oil and nitrogen, phosphorus, and total organic carbon. The pilot historical pollution study was broken down into categories of pollutant sources and receptors chosen on the basis of the availability and reliability of the supporting quantitative data. Reliable information on past as well as present pollution is essential for understanding long-term environmental trends. The historical materials-balance studies that have been performed so far reveal new insights about the complex network between old pollution sources and the ultimate fate of the contaminants released into the Hudson-Raritan basin. (Khumbatta-PTT)
W87-01506

OCTANOL:WATER PARTITION COEFFICIENTS (P): MEASUREMENT, ESTIMATION, AND INTERPRETATION, PARTICULARLY FOR CHEMICALS WITH P > 100000,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
D. N. Brooke, A. J. Dobbs, and N. Williams.
Ecotoxicology and Environmental Safety EESADV, Vol. 11, No. 3, p 251-260, June 1986. 6 fig, 5 tab, 22 ref.

Descriptors: *Path of pollutants, *Octanol, *Water partition coefficient, *Partition coefficient, *Bioconcentration, Biological magnification, Chromatography, Fish.

The octanol:water partition coefficient occupies a key position in the early stages of an environmental assessment of a new chemical. Considerable difficulties are being faced in the measurement, estimation, and interpretation of chemicals that have very large partion coefficients (greater than 100000). Some aspects of those problems and some of the recent relevant work at the Princes Risborough Laboratory are discussed including the methods of measuring high partition coefficients, methods of estimation, the use of high performance liquid chromatography (HLPC) and the interpretation of high partition coefficients in terms of fish bioconcentration. Particular reference has been given to high values (log P greater than 5), while discussing the methods for measurement and estimation of octanol:water partition coefficients. A novel experimental method for P measurement is described, and preliminary results presented. The use of HPLCcapacity factors for estimating P values has been investigated; better correlations between two parameters have been found if HPLC results at different methanol:water liquid phases are extrapolated to pure water, but even this procedure does not always give reliable P values. The interpretation of high log P values in terms of fish bioconcentration has been discussed and the correlations of molecular connectivity and molecular weight with fish bioconcentration have been presented. (Khumbatta-PTT)
W87-01508

FINITE ANALYTIC NUMERICAL SOLUTION FOR TWO-DIMENSIONAL GROUNDWATER SOLUTE TRANSPORT,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W87-01529

REACIDIFICATION MODEL FOR ACIDIFIED LAKES NEUTRALIZED WITH CALCITE,
Lund Univ. (Sweden). Dept. of Chemical Engineering.
H. Sverdrup, and P. Warfvinge.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1374-1380, September 1985. 13 fig, 2 tab, 19 ref.

Descriptors: *Acid Rain, *Reacidification, *Acidification, *Model studies, *Acid lakes, *Calcite, *Neutralization, Lakes, Chemical properties, Water, Acidic water, Calcium, Sediments.

The reacidification of limed lakes depends on the dilution of the dissolved calcium carbonate with time and the dissolution of calcite from the lake sediments. Calcite on the lake bottom will, in addition to being covered by sedimentation, become inactivated by precipitates of humus and clay minerals clogging the calcite surfaces. A model has been developed to calculate the reacidification of a limed lake using the following mechanisms: (1) the dissolution of calcite and a subsequent neutralization of acid water, (2) owing to the increase in pH value, occurrence of precipitation of humus and dissolved metals onto the calcite surface and inhibition of the dissolution of calcite, (3) reversible sorption of calcium from the water column by sediments not covered with calcite, and (4) diffusive transport through a boundary bottom layer to the water column. The lake initially was modeled as a continuously stirred tank. The equations were derived from a mass balance and the dissolution kinetics for calcite to describe the long-term development of pH, alkalinity, and calcium concentration. The model accurately describes the reacidification and the mass balances observed in several limed lakes. (Author's abstract)
W87-01531

PHOSPHORUS ADSORPTION TO RIVERINE SUSPENDED MATTER: IMPLICATIONS FOR THE P-BUDGET OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W87-01546

MERCURY DISTRIBUTION IN A POLLUTED MARINE AREA, RATIO OF TOTAL MERCURY, METHYL MERCURY AND SELENIUM IN SEDIMENTS, MUSSELS AND FISH,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
N. Mikac, M. Picer, P. Stegnar, and M. Tusek-Znidaric.
Water Research WATRAG, Vol. 19, No. 11, p 1387-1392, 1985. 3 fig, 3 tab, 31 ref.

Descriptors: *Mercury, *Methyl mercury, *Path of Pollutants, *Selenium, *Sediments, *Mussels, *Fish, *Marine environment, *Water pollution, Molluska, Coastal waters, Chemical analysis, Water analysis, Industrial wastes, Chemical wastes.

Concentrations of total mercury, methyl mercury, and selenium were measured in sediments and organisms from the Kastela bay in the Central Adriatic, polluted with inorganic mercury by a chlor-alkali plant. Sediments and mussels (Mytilus galloprovincialis) contained high total mercury concentrations, especially in the vicinity of the pollution source. The percentage of mercury in the methyl form increased from surface sediments (up to 1.37%) to the edible parts of mussels (0.1-27%, negatively correlated with total mercury concentrations) and to the fish, in which methyl mercury accounted for most of the mercury in the muscle tissue. (Author's abstract)
W87-01552

BIOASSAYS WITH STIGEOCLONIUM TENUE KUTZ. ON WATERS RECEIVING SEWAGE EFFLUENTS,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
For primary bibliographic entry see Field 5A.
W87-01554

IDENTIFICATION OF HIGHLY CHLORINATED ETHERS AND DIETHERS IN RIVER SEDIMENT NEAR AN EPICHLOROHYDRIN PLANT,
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W87-01555

TOTAL DISSOLVED PHOSPHORUS: EFFECTS OF TWO MOLECULAR WEIGHT FRACTIONS ON PHOSPHORUS CYCLING IN NATURAL PHYTOPLANKTON COMMUNITIES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2H.
W87-01560

MEASUREMENT AND MODELING OF WESTERN WASHINGTON PRECIPITATION CHEMISTRY,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. J. Vong, T. V. Larson, D. S. Covert, and A. P. Waggoner.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 1, p 71-84, September 1985. 4 fig, 5 tab, 28 ref.

Descriptors: *Air pollution, *Path of pollutants, *Model studies, *Washington, *Precipitation, *Chemical properties, *Rain, Chemical analysis, Water analysis, Heavy metals, Water pollution sources, Hydrologic budget, Sulfates.

Precipitation was collected and chemically analyzed for one year at four sites in western Washington. Spatial and seasonal variabilities in concentrations were identified with the highest concentrations nearest emission sources and in the summer. Multiple correlations among measured species revealed five groupings which were interpreted as the influences of seasalt, metals from a copper smelter, an urban factor, soil, and acidic sulfate aerosol. A simple washout model predicted that the copper smelter was the major contributor to a rainwater sulfate budget. Measurement uncertainties were estimated for each analyte. (Author's abstract)
W87-01561

LEACHABILITY OF RADIUM FROM URANIUM MILL TAILINGS,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
P. M. Markose, M. Raghavayya, and K. C. Pillai.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 1, p 95-104, September 1985. 2 fig, 9 tab, 10 ref. International Atomic Energy Agency Contract 2895/RB.

Descriptors: *Path of pollutants, *Leaching, *Radium, *Uranium, *Mine wastes, *Water pollution sources, Fate of pollutants, Mineral industry, Reservoirs, India, Particle size, Chemical properties.

Tailings from uranium ore processing operations are returned to the mine as back-fill or dumped in a man-made or natural impoundment facility. This impoundment becomes the repository of a significant amount of radium, which may be dissolved and transported under favorable conditions. Investigations were carried out on the dissolution of radium from the tailings pond of the acid-leach processing plant operating in India. The size fraction analysis of the deposited tailings indicated that 80% of the particles had sizes below 74 microns. The specific activity of radium in tailings increases as the particle size decreases. Only 0.5% of radium from tailings were solubilized by leaching with rain water. Chloride ions enhanced the leachability of radium by more than 13%. Ammonium acetate, ammonium nitrate, and EDTA removed 20%, 30%, and 65% of the radium, respectively. The containment of tailings is essential in view of its potential for release of radium into the environment. (Author's abstract)
W87-01562

SEASONAL VARIATIONS OF TRACE ELEMENTS IN DISSOLVED AND SUSPENDED LOADS FOR COAL ASH PONDS AND POND EFFLUENTS,
Savannah River Ecology Lab., Aiken, SC.
J. J. Alberts, M. C. Newman, and D. W. Evans.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 2, p 111-128, October 1985. 8 fig, 5 tab, 26 ref. DOE Contract EY-76-C-09-0819.

Descriptors: *Path of pollutants, *Seasonal variation, *Trace elements, *Dissolved solids, *Suspended solids, *Coal ash ponds, *Effluents, *Fate of pollutants, Settling basins, Streams, Heavy metals, Physical properties, Chemical properties.

Concentrations of elements in solution and in suspended solids were determined in a settling basin/creek system receiving bottom ash, cyclone ash, fly ash, and electrostatic precipitator ash. The concentrations of arsenic, calcium, cadmium, chromium, copper, iron, magnesium, manganese, and zinc as well as physico-chemical parameters were compared for multiple sites in the basin/creek system and a pond without ash inputs from autumn to late summer. Comparison with published results obtained six to seven years earlier showed no significant change. Chemical speciation calculations indicate that most of the elements remained in the free hydrated or sulfate form throughout the study period. Copper and iron exhibit some shifts in the concentrations of the hydroxy and carbonate complexes in responses to seasonal and biological factors. (Author's abstract)
W87-01563

BUFFER CAPACITY OF FOREST SOILS IN NEW ENGLAND,
Northeastern Forest Experiment Station, Durham, NH.
C. A. Federer, and J. W. Hornbeck.
Water, Air, and Soil Pollution WAPLAC, Vol. 2o, No. 2, p 163-173, October 1985. 4 fig, 2 tab, 21 ref.

Descriptors: *Buffer capacity, *Forest soils, *New England, *Soil chemistry, *Soil properties, Soil horizons, Cations, Acidity, Bases, Acid rain, Rainfall.

Buffer capacity was measured for major horizons of forest soils from four locations in New England by titration of field-moist samples with either HCl or NaOH. Titration curves for O horizons were nearly linear over a wide pH range; i.e., buffer capacity was independent of pH. Titration curves for mineral horizons were S-shaped with ambient pH roughly in the middle of the least buffered part of the curve. Divalent calcium and magnesium ions in KCl extractions at ambient pH were found to be only slightly less than in NH4OAc extractions at pH 7, implying that exchangeable bases did not depend much on the extraction pH. The O horizons were generally highly base-saturated at ambient pH, even though their pH was low; mineral soils had lower base saturation. Buffer capacity measured over the first 0.5 pH unit to the acid side depended strongly on organic matter fraction in the sample. All soil materials studied had buffer capacities per unit organic mass of about 100 meq per kg per pH unit. Acid rain at pH 4.0 in New England would take at least several decades to lower pH of the soil profile by a whole pH unit. (Author's abstract)
W87-01565

UPTAKE OF CADMIUM, LEAD AND NICKEL BY CORN GROWN IN CONTAMINATED SOILS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
M. Sadiq.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 2, p 185-190, October 1985. 1 fig, 4 tab, 14 ref.

Descriptors: *Cadmium, *Lead, *Nickel, *Accumulation, *Corn, Heavy metals, Plant physiology, Nutrients, Calcareous soils, Soil types.

Sixteen calcareous soil samples were spiked with cadmium, lead, and nickel. Corn was grown for one month in these soils six months after metal additions, and analyzed for cadmium, lead, nickel, copper, iron, manganese, and zinc. Total and DTPA extractable concentrations of the above metals also were determined in the experimental soils. The concentrations of cadmium, lead, and nickel in the corn plants varied significantly ($P < 0.05$). In corn, cadmium accumulated in higher amounts followed by lead and nickel. The concen-

trations of cadmium in corn were significantly correlated with the DTPA-extractable cadmium in the soil samples. There was no significant correlation between the concentrations of nickel and lead in the corn and the DTPA-extractable levels of these metals in the experimental soils. Although manganese, copper, and zinc in corn were significantly correlated to their respective DTPA-extractable concentrations in the soils, the confidence intervals for these elements were wide. Iron in the corn plants was not significantly correlated to DTPA-extractable iron in the amended soils. These results indicate that DTPA soil test may not predict plant available micronutrients in the contaminated soils. (Author's abstract)
W87-01566

CHEMICAL CHANGES IN A RECEIVING STREAM DUE TO OXYGENATION AND DILUTION OF MINE TAILINGS SEEP WATERS,
Montana State Univ., Bozeman. Dept. of Chemistry.
J. M. Babb, S. K. Enger, and G. K. Pagenkopf.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 3, p 219-224, November 1985. 1 fig, 3 tab, 19 ref.

Descriptors: *Oxygenation, *Streams, *Chemical properties, *Mine wastes, *Seep water, *Water pollution effects, Chemical reactions, Water.

Chemical changes and phase distributions for major and minor chemical constituents have been determined for High Ore Creek, Montana. The major chemical reaction is oxidation of Fe(II) to Fe(III). Subsequent Fe(III) hydrolysis provides a major portion of the suspended phase. The presence of colloidal hydrous oxides rapidly removes copper, lead, and arsenic from the solution phase. The concentrations of iron and arsenic decrease by a factor of more than 500; manganese and zinc decrease by at least a factor of 15. The variations in the concentrations of sodium, potassium, calcium, magnesium, bicarbonate, and sulfate primarily parallel dilution factors which are in the range of two to three. (Author's abstract)
W87-01568

RATE OF LAKE ACIDIFICATION IN FOUR LAKES NORTH OF LAKE SUPERIOR AND ITS RELATIONSHIP TO DOWNCORE SULPHUR ISOTOPE RATIOS,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
M. D. Dickman, and H. G. Thode.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 3, p 233-253, November 1985. 7 fig, 4 tab, 30 ref.

Descriptors: *Lakes, *Acid rain, *Acidification, *Lake Superior, *Sulfur, *Isotope fractionation, Lake sediments, Chemical properties, Mineral industry, Air pollution effects.

Surficial sediments from three lakes located within 20 km of a large siderite sintering plant were analyzed for sulfate, pyrite, organic and total sulfur, and subfossil diatoms. One lake was undergoing rapid acidification, while the other two were increasing in pH over the last 30 years. Lakes closest to the sintering plant had the highest sulfur concentrations in their sediments. Pyrite concentrations were significantly higher in surface sediments than in deeper sediments. The sulfur isotope ratios in the various forms of sulfur in the deeper (10-12 cm) sediments were fairly uniform in all study lakes, almost identical to those of a control lake. This suggests little or no sulfur isotope fractionation during sulfate reduction and precipitation of sulfides at the time of sediment deposition about 100 years ago. Sulfur isotope ratios in surface sediments (0-2 cm) were shifted toward negative values. The shift ranged from 14% to 16% in the study lakes, and 1.5% to 5.0% in the control lakes. The shift in the recent sediments may result from isotope fractionation in the dissimilatory reduction of lake sulfate by bacteria stimulated by anthropogenic inputs of sulfur. (Doria-PTT)
W87-01570

DISTRIBUTION OF METAL POLLUTION IN GROUNDWATER DETERMINED FROM SUMP SLUDGES IN WELLS,
Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland).
E. Hoehn, and H. R. von Gunten.
Water Science and Technology WSTED4, Vol. 17, No. 9, p 115-132, September 1985. 7 fig, 3 tab, 24 ref.

Descriptors: *Metals, *Pollutants, *Groundwater pollution, *Wells, *Sumps, *Sludge, Fate of pollutants, Path of pollutants, Heavy metals, Pollution sources, Aquifers, Interstitial water, Infiltration, Manganese, Organic carbon, Rivers.

Sludge material from the bottom of groundwater sampling wells was investigated at a site near an infiltrating river in order to obtain information about the distribution of metals and their partitioning between sediments and interstitial waters. The concentrations of the dissolved metals in the interstitial water fluctuated more from well to well than the metal concentrations in the sludge sediments. The concentrations of most of the investigated heavy metal trace elements decreased with increasing grain sizes, indicating their sorption from solution. The concentration pattern at different grain size fractions was correlated with the organic carbon and manganese content of the sediments. Some of the metals exhibited higher concentrations in the near field of the river than in the far field, implicating the river as a source for these metals. The physicochemical conditions in the sludges are different from those in the aquifer with its flowing groundwater. (Doria-PTT)
W87-01580

TRACE METAL SPECIATION IN A SOIL PROFILE IRRIGATED WITH WASTE WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. V. Mattigod, P. F. Pratt, and E. B. Schalscha.
Water Science and Technology WSTDE4, Vol. 17, No. 9, p 133-142, September 1985. 4 tab, 14 ref.

Descriptors: *Trace metals, *Path of pollutants, *Wastewater, *Soil profiles, *Irrigation, *Wastewater irrigation, *Fate of pollutants, Profiles, Model studies, Computer programs, Chemical properties, Chemical reactions, Adsorption.

A chemical equilibrium computer model was used to predict the trace metal behavior in a soil profile subjected to a long-term irrigation with waste waters. Various categories of interactions were simulated. The metal-soluble organic interactions were accounted for by a mixture model. The computations included a 10 metal - 15 ligand system with 262 soluble complex species and 21 possible solid phases. The results predicted that a major fraction of alkali elements in solution tend to be in free ionic forms, whereas major fractions of the alkaline earths were in adsorbed and/or precipitated forms. Significant soluble fractions of transition series metals were predicted to be in adsorbed and/or complexed forms. The degree of attenuation of these transition series elements moving through the soil profile seems to be governed mainly by the degree of adsorption on soil surfaces and the tendency of these elements to form soluble organic complexes. The predicted mobilities of these elements in this soil profile was Cu > Ni > Zn > Cd. Application of this equilibrium model appears to provide a first approximation approach to simulate the trace element behavior in soil profiles. (Doria-PTT)
W87-01581

WATER AND AIR INTAKE OF SURFACE-EXPOSED ROCK FRACTURES IN SITU,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2A.
W87-01593

COMPARISON OF CHEMICAL AND ISOTOPIC HYDROGRAPH SEPARATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2B.
W87-01594

HEAVY METALS IN LAKE KINNERET (ISRAEL): I. TOTAL COPPER AND CUPRIC ION CONCENTRATIONS IN LAKE KINNERET AND THE RIVER JORDAN,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
T. Frevert.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 527-542, October 1985. 4 fig, 3 tab, 37 ref.

Descriptors: *Heavy metals, *Lake Kinneret, *Israel, *Copper, *Jordan River, Seasonal variation, Fate of pollutants, Path of pollutants, Chemical analysis, Chemical precipitation.

Total and acid-dissolvable copper (DPASV after HNO3 addition and H2O2/UV treatment) and cupric ion concentrations were determined in Lake Kinneret, Israel (during summer stagnation and after winter overturn) and in its main tributary, the River Jordan. Total copper concentrations in Lake Kinneret and the River jordan are almost one order of magnitude higher than pristine lacustrine concentrations (due to more recent references). Total copper concentrations (after UV treatment of the sample) in Lake Kinneret are insignificantly (only 5-6%) higher than mineral concentrations (after HNO3 addition). CuOH(+), Cu(OH)2 and CuCO3 will be the pertinent copper complexes in Kinneret and Jordan water (although in Jordan water strong organic complexes may prevail with high water levels in spring time). The major riverine copper fraction is bound to inorganic or acid-dissolvable organic particulate. It may be precipitated by authigenic particularization in the epilimnion, as well as sulfide precipitation in the hypolimnion during summer stagnation. During the mixing period of the lake it will be released again into the overlying water. Cu(2+) aqueous concentrations as computed by a potentiometric technique detected operational partitioning coefficient (alpha)(25+ or - 0.2 C) values. Total copper concentrations seem to be sufficiently high in Kinneret water to affect algal development. Lake Kinneret might, therefore, belong to the probably few lakes where the natural Cu input has a permanent impact on composition and growth of the algal community. (Lantz-PTT)
W87-01602

ACTIVE NITRIFICATION IN THE HYPOLIMNION OF LAKE KIZAKI IN EARLY SUMMER: 1. NITRIFYING ACTIVITY OF RAPIDLY SINKING PARTICLES,
Nagoya Univ. (Japan). Water Research Inst.
T. Yoshioka, M. Takahashi, and Y. Saijo.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 557-570, October 1985. 3 fig, 6 tab, 25 ref.

Descriptors: *Nitrification, *Hypolimnion, *Lake Kizaki, *Particulate matter, Seasonal variation, Nitrogen fixing bacteria, Ammonia, Nitrates.

Rapidly sinking particulate matter was collected by sediment traps at 15 m depth in Lake Kizaki, during May to August 1982. Potential nitrifying activities of water (15 m) and trap samples, were measured with inhibitors, and the enumerations of nitrifying bacteria (MPN method) were carried out. The potential nitrifying activities of water samples corresponded to the course of in situ nitrification, reaching a maximum on 10 July (0.65 micrograms-at N/L/day). Those of trap samples reached a maximum on 14 July (0.48 micrograms-at N/L/day). Although both numbers of ammonium and nitrite oxidizing bacteria in the trap samples were about 100 times more than in the water samples, the nitrifying activity levels of the trap samples were the same as those of the water samples. Therefore, it is suggested that the nitrifying bacteria attached to the rapidly sinking particulate matters might be inactive, and that the nitrification in the hypolimnion of Lake Kizaki during the early summer is caused not by them, but by the nitrifying bacteria suspended in the water column. (Author's abstract)

W87-01604

NITROGEN FIXATION (ACETYLENE REDUCTION) IN PLANKTIC CYANOBACTERIA IN OREGRUNDSGREPEN, SW BOTHNIAN SEA,
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
For primary bibliographic entry see Field 2L.
W87-01605

DYNAMICS OF CHLOROPHYLL AND PHOTOSYNTHESIS IN NATURAL PHYTOPLANKTON ASSOCIATIONS: I. SEASONAL AND ANNUAL CYCLES OF CHLOROPHYLL AND PHAEOPIGMENTS, IN RELATION TO EUPHOTIC DEPTH AND THEIR VERTICAL DISTRIBUTION IN SMALL NORTHGERMAN LAKES,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
M. -E. Meffert, and J. Overbeck.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 219-234, August 1985. 10 fig, 3 tab, 48 ref.

Descriptors: *Chlorophyll, *Limnology, *Photosynthesis, *Phytoplankton, *Algal growth, Seasonal variation, Germany, Lakes, Plussee, Temperature, Radiation, Algal growth, Eutrophication, Euphotic zone.

In 1981, weekly investigations were made into the relationship between chlorophyll levels and the depth of the euphotic zone and extinction coefficients in the Plussee. Chlorophyll and phaeopigment production was studied in relation to the algal growth phases, depth, global radiation and temperature. Chlorophyll specific and the non-algal light attenuation were estimated and compared with data from other lakes. In the euphotic zone, the mean annual level of chlorophyll-a was about 20 mg/cu m or 80 mg/sq m, over the ranges 1-60 mg/cu m or 8-22 mg/sq m. Maxima of about 100 mg/cu m were observed corresponding to earlier findings. Phaeopigment levels increased from about 15% of chlorophyll-a to about 200% in metalimnetic layers and during algal decline. The chlorophyll maxima varied over the years of investigation, being highest in 1981. Several algal assemblages with short periods of dominance formed numerous chlorophyll peaks, which together produced 3 major blooms. Chlorophyll maxima could occur at any depth between the surface and 10 m. Distinct epilimnetic and metalimnetic chlorophyll maxima were seen in spring and late summer, respectively. (Author's abstract)
W87-01607

STRUCTURE, CELL DIFFERENTIATION AND LIFE CYCLE OF BLUE-GREEN ALGA NODULARIA HARVEYANA (THWAITES) THURET,
National Botanical Research Inst., Lucknow (India).
For primary bibliographic entry see Field 2H.
W87-01608

ALTERATION OF IRON-CACO3 PRECIPITATION BY YELLOW ORGANIC ACIDS OF AQUATIC ANGIOSPERM ORIGIN,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W87-01609

INFLUENCE OF THE MOBILITY OF POTAMOPYRGUS JENKINSI (SMITH, E.A.) (PROSOBRANCHIA:HYDROBIIDAE) ON ITS SPREAD,
University of the South Pacific, Suva (Fiji). School of Natural Resources.
For primary bibliographic entry see Field 2H.
W87-01617

SIMULATION OF MICROBIAL GROWTH DYNAMICS COUPLED TO NUTRIENT AND OXYGEN TRANSPORT IN POROUS MEDIA,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, M. A. Widdowson, and L. D. Benefield.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1207-1216, August 1986. 15 fig, 30 ref.

Descriptors: *Path of pollutants, *Fate off pollutants, *Microbiological studies, *Growth kinetics, *Groundwater pollution, *Biodegradation, *Solute transport, Nutrients, Oxygen, Degradation, Simulation analysis, Model studies, Hydraulic conductivity, Aquifers, Mathematical studies, Mathematical analysis, Aerobic conditions, Anaerobic conditions.

A model for simulating microbial growth-degradation processes in porous media assumes that the bulk of microorganisms in an aquifer grow in microcolonies attached to matrix surfaces. The model applies to the growth and decay of aerobic, heterotrophic microorganisms whose growth is limited by lack of a carbon and energy source (substrate), an oxygen source or both simultaneously as described by modified Monod kinetics. Transport of substrates and oxygen in the porous medium is assumed to be governed by advection-dispersion equations with surface adsorption. A total of five coupled equations result, describing substrate and oxygen concentrations in the pore fluid, substrate and oxygen concentrations in the microcolonies and colony density, which is assumed sufficiently small so that aquifer hydraulic conductivity is not diminished. An iterative process involving an Eulerian-Lagrangian numerical procedure, that is highly resistant to numerical dispersion in the presence of small dispersivities, is used to solve the overall model, with parameter values selected from the literature or estimated. Results indicate that biodegradation would be expected to have a major effect on contaminant transport when proper conditions for growth exist. For one-dimensional transport in a column, the most rapid microbial growth always occurred at the influent boundary where oxygen and substrate concentrations were held constant independent of colony density. Anaerobic conditions develop rapidly and aerobic biodegradation ceases if large amounts of substrate are added to the system. (Author's abstract)
W87-01622

INTEGRAL SOLUTION FOR THE DIFFUSION-ADVECTION EQUATION,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
A. Taigbenu, and J. A. Liggett.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1237-1246, August 1986. 13 fig, 2 tab, 20 ref. NSF Grant CEE7902803.

Descriptors: *Diffusion, *Advection, *Mathematical equations, *Path of pollutants, *Groundwater movement, Differential equations, LaPlace equation, Mathematical studies, Porous media.

A new integral formulation, based on Green's second identity, is used to solve the unsteady transport (diffusion-advection) equation which governs the storage and movement of pollutants in porous media. It uses the fundamental solution for the terms of the differential equation with the highest derivatives (the order of the equation) and, by applying Green's second identity, those terms are cast into a boundary integral while the remaining terms with lower derivatives are weighted with that fundamental solution and integrated over the solution domain. The resulting integral representation is no longer a boundary integral but comprises both boundary and domain integral portions. Because the terms with the highest derivatives constitute the Laplacian, the fundamental solution employed in the formation is the logarithmic function. The boundary integral portion of the formulation is similar to that encountered when the boundary element method is applied to the elliptic equations but the domain portion, which contains the temporal derivative and advection terms, is evaluated by discretizing the solution domain into elements, as is frequently done in finite element formulations. The classic one-dimensional semi-infinite and a two-dimensional semi-infinite diffusion-advection problems are solved for a wide range of local Peclet numbers to verify and demonstrate the usefulness of the present formulation. The results are satisfactory. (Authors' abstract)
W87-01625

RADIONUCLIDE TRANSPORT IN FAST CHANNELS IN CRYSTALLINE ROCK,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
A. Rasmuson, and I. Neretnieks.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1247-1256, August 1986. 14 fig, 2 tab, 13 ref.

Descriptors: *Radionuclides, *Flow profile, *Path of pollutants, *Groundwater movement *Crystalline rocks, Diffusion, Finite difference methods, Solute transport, Radioisotopes.

Recent field investigations in crystalline rock give strong indications that water flows in largely isolated channels in fissured rock. The present paper sets out to investigate radionuclide transport in such channels including diffusion into the rock matrix. It is shown that the uptake from a cylindrical hole in a matrix is much more effective, per unit contact area, than a flat surface (semi-infinite solid). Comparison of diffusion from cylindrical and slit-formed channels shows that the differences in interfacial flux are minor. A slit-formed channel may therefore be approximated by a cylindrical one. Diffusional transport in the matrix is then treated as one dimensional instead of two dimensional, which gives a considerable numerical simplification. A simple estimate of the 'penetration depth' into the cylindrical region, i.e., the location of the diffusional front, is proposed. By using the integrated finite difference method a number of radionuclide transport calculations are performed for the case of flow and dispersion in a cylindrical channel coupled to diffusion and sorption in the matrix. (Author's abstract)
W87-01626

STATISTICAL METHODOLOGY FOR ESTIMATING TRANSPORT PARAMETERS: THEORY AND APPLICATIONS TO ONE-DIMENSIONAL ADVECTIVE-DISPERSIVE SYSTEMS,
Geological Survey, Menlo Park, CA. Water Resources Div.
B. J. Wagner, and S. M. Gorelick.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1303-1315, August 1986. 7 fig, 5 tab, 30 ref, append.

Descriptors: *Statistical methods, *Theoretical analysis, *Advection, *Dispersion, *Path of pollutants, Contaminant transport, Simulation analysis, Regression analysis, Monte Carlo Method, Data interpretation, Streams, Statistical models, California.

Finite difference contaminant transport simulation is combined with a nonlinear weighted least squares multiple-regression procedure. The technique provides optimal parameter estimates and gives statistics for assessing the reliability of these estimates under certain general assumptions about the distributions of the random measurement errors. Monte Carlo analysis is used to estimate parameter reliability for a hypothetical homogeneous soil column for which concentration data contain large random measurement errors. The value of data collected spatially versus data collected temporally was investigated for estimation of velocity, dispersion coefficient, effective porosity, first-order decay rate, and zero-order production. The use of spatial data gave estimates that were 2-3 times more reliable than estimates based on temporal data for all parameters except velocity. A comparison of estimated linear and nonlinear confidence intervals based upon Monte Carlo analysis, showed that the linear approximation is poor for dispersion coefficient and zero-order production coefficient when data are collected over time. In addition, examples demonstrate transport parameter estimation for two real one-dimensional systems. First, the longitudinal dispersivity and effective porosity of an unsaturated soil are estimated using laboratory column data. The reliability of estimates are then compared, based upon data from individual laboratory experiments versus estimates

based upon pooled data from several experiments. Second, the simulation nonlinear regression procedure is extended to include an additional governing equation that describes delayed storage during contaminant transport. The model is applied to analyze the trends, variability, and interrelationship of parameters in a mountain stream in northern California. (Author's abstract)
W87-01632

EFFECTS OF HETEROGENEOUS ADSORPTION BEHAVIOR ON ION TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. C. Parker, and P. M. Jardine.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1334-1340, August 1986. 7 fig, 3 tab, 21 ref.

Descriptors: *Path of pollutants, *Adsorption, *Ion transport, *Heterogeneity, *Mathematical models, Mathematical studies, Model studies, Equilibrium, Kinetics, Potassium, Calcium, Ion exchange, Soil water.

A nonlinear, nonequilibrium, two-site adsorption model was employed to describe ion transport in soil subject to binary monovalent-divalent cation exchange. The model assumed that adsorption sites can be divided into two fractions each exhibiting different equilibrium and kinetic adsorption behavior. Equilibrium isotherms for binary exchange at constant ionic strength are described by the Vanselow equation with selectivity coefficients, k sub v for each site taken as functions of the solid phase equivalent fractions of exchanging ions. To evaluate the effects of concentration-dependent selectivity on ion transport, a numerical solution of the convection-dispersion equation incorporating the nonlinear absorption model was used to simulate K-Ca exchange for a sandy soil using a measured concentration-dependent k sub v reported in a previous study, for equilibrium- and kinetic-controlled adsorption sites. Breakthrough curves are simulated for various solution ionic strengths and kinetic rate coefficients using (1) measured k sub v functions, (2) single-valued K sub v obtained by different procedures, and (3) an otherwise analogous model with a linearized isotherm. Errors which may be incurred by employing the various simplified models for the direct problem solution, as well as implications of parameter estimation analyses for the inverse problem, are discussed. (Author's abstract)
W87-01635

NWWA CONFERENCE ON SURFACE AND BOREHOLE GEOPHYSICAL METHODS IN GROUND WATER INVESTIGATIONS.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 2F.
W87-01641

SELECTION OF PROPER SURFACE RESISTIVITY TECHNIQUES AND EQUIPMENT FOR EVALUATION OF GROUNDWATER CONTAMINATION,
JRB Associates, Inc., McLean, VA.
D. Pennington.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 23-33, 1 ref.

Descriptors: *Resistivity, *Geophysical surveys, *Groundwater pollution, *Water quality management, Case histories, Geophysics, Electrical studies, Electrodes, Data acquisition, Data interpretation, Computers.

This study was conducted to improve the cost effectiveness of geophysical programs at hazardous waste sites. Major problems identified as part of this study are the improper use of equipment, inadequate interpretation methods, poor field procedures, the improper application of electrode configurations, and the use of non-applicable resistivity techniques for a specific site. Factors affecting the suitability of such standard electrode arrays as Wenner, Schlumberger and Dipole-Dipole are discussed. Of the standard electrode arrays, the Schlumberger Array, has been the most sensitive to many environments in identifying groundwater contamination. The advantages to various resistivity arrays, with examples, are assessed. To help determine the equipment required for a site, criteria for equipment selection are identified. In particular, the use of alternative current resistivity systems is discussed. Various interpretative techniques are also identified to maximize the use of suitable field data. Some of these techniques include methods to evaluate equivalence problems, and problems caused by lateral heterogeneities, current leakage, and electrode spacing errors. Both manual and computer analyses are discussed. Manual curve matching and various computer models are analyzed and compared. As part of this analysis, the number of geophysical stations required before computer models become cost effective for interpretation of data was identified. For the Schlumberger technique, between 25 and 30 geophysical stations were required before computer analysis was needed. The total number of geophysical stations which could be manually completed was dependent on the complexity of geoelectric layering found at a particular site. (See also W87-01641) (Lantz-PTT)
W87-01644

APPLICATION OF AN AUTOMATIC EARTH RESISTIVITY SYSTEM FOR DETECTING GROUND WATER MIGRATION UNDER A MUNICIPAL LANDFILL,
Southwest Research Inst., San Antonio, TX.
For primary bibliographic entry see Field 7B.
W87-01645

TERRAIN CONDUCTIVITY AS A TOOL FOR DELINEATING HYDROCARBON PLUMES IN A SHALLOW AQUIFER - A CASE STUDY,
Woodward-Clyde Consultants, Houston, TX.
For primary bibliographic entry see Field 7B.
W87-01646

GEOPHYSICAL MONITORING OF AN INJECTED CONTAMINANT PLUME: EXPERIMENTS WITH A DISPOSABLE E-LOG,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W87-01647

MONITORING OF SUBSURFACE CONTAMINANTS WITH BOREHOLE/SURFACE RESISTIVITY MEASUREMENTS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 7B.
W87-01652

CORRELATION BETWEEN FIELD GEOPHYSICAL MEASUREMENTS AND LABORATORY WATER SAMPLE ANALYSIS,
Technos, Inc., Miami, FL.
R. C. Benson, M. S. Turner, W. D. Volgelsong, and P. P. Turner.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 178-197, 6 fig, 4 ref.

Descriptors: *Geophysics, *Field tests, *Water sampling, *Water analysis, *Water quality, *Path of pollutants, *Plumes, Resistivity, Electromagnetic waves, Contamination, Correlation analysis, Electrical studies, Specific conductivity.

Two surface geophysical methods--Resistivity and Electromagnetics--have been used extensively to map contaminant plumes having elevated specific conductance values. Because the measured values are dominated by the specific conductance of the pore fluids, they can be related to specific conductance of water samples. Specific conductance is one of the indicator parameters identified by the EPA and provides an easily measured and reliable means of estimating the overall water quality. The correlation between laboratory analysis and electrical geophysical measurements has been reviewed for three typical waste disposal sites which represent a cross section for the types of sites commonly encountered. The three sites selected are: a municipal landfill, an uncontrolled artesian well with brackish water, and waste water basins at a fossil fuel power plant. In the three examples presented, the indicator parameter, specific conductance, correlates well (.903, .959, and .768 at a 95% confidence level) with resistivity or electromagnetic measurements. The high degree of correlation between surface electrical geophysical measurements and laboratory water analyses supports the following conclusions: (1) Surface geophysical measurements of a conductive plume are related to the groundwater chemistry; (2) A key indicator parameter, specific conductance, correlates with electrical geophysical measurements; (3) In one example, total organic carbon (TOC) was measured, and there was correlation between the surface geophysical measurements and TOC; (4) The geophysical measurements show good agreement with other chemical measurements; (5) The geophysical data can be used in a qualitative manner to delineate the extent of a plume and indicate its flow direction, and (6) The geophysical data can be 'calibrated' to provide quantitative contours of specific conductance or other chemical parameters. (See also W87-01641) (Lantz-PTT)
W87-01653

COMPARATIVE ANALYSIS OF SURFACE RESISTIVITY SURVEYS AND NATURAL-GAMMA RADIATION BOREHOLE LOGS IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W87-01655

MAGNETIC SURVEY METHODS USED IN THE LUITIAL ASSESSMENT OF A WASTE DISPOSAL SITE,
BCM Engineers, Inc., Plymouth Meeting, PA.
J. W. Fowler, and D. L. Pasicznyk.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 267-281, 9 fig, 7 ref.

Descriptors: *Magnetic studies, *Geophysical surveys, *Waste disposal, *Surveys, Measuring instruments, Magnetometer, Landfills, Path of pollutants, Water quality control, Conductivity, Radar, Subsurface mapping.

A reconnaissance magnetic survey using a proton precession magnetometer provided a rapid costs-effective means of delineating subsurface concentrations of buried drums and other ferromagnetic material at a waste disposal site. Approximately 11 acres of highly magnetic zones were identified during the survey. These areas represented trenches and individual burial areas for steel drums. Confirmation of survey results was obtained by construction of test pits over magnetic anomalies and within identified 'clean' areas. A 100% confirmation of magnetic survey results was obtained. In addition to the magnetic survey, subsurface radar and terrain conductivity surveys were conducted over selected landfilled areas. The radar survey detected complex subsurface strata and buried metallic and non-metallic objects within the landfill. These data served to confirm magnetic survey results and detected areas where apparently non-magnetic waste material was located. However, over major portions of the landfill, the radar could not differentiate between possible 'clean' fill deposited in a random manner and waste debris. A terrain conductivity survey conducted concurrently with the radar survey over a magnetic survey anomaly detected elevated conductivity over the suspected burial trench and a possible plume of elevated conductivity in proximity to the trench. Both the radar and terrain conductivity surveys yielded data complementary to the magnetic survey data. Geophysical surveys reduced the cost and improved the effectiveness of subsequent subsurface exploration. (See also W87-01641) (Lantz-PTT)
W87-01658

APPLICATION OF THE CONTROLLED SOURCE AUDIO MAGNETOTELLURICS (CSAMT) SURVEY TO DELINEATE ZONES OF GROUND WATER CONTAMINATION - A CASE HISTORY,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 7B.
W87-01659

DRY HOLE RESISTIVITY LOGGING,
Converse Consultants, Inc., Las Vegas, NV.
For primary bibliographic entry see Field 7B.
W87-01664

USE OF DOWNHOLE GEOPHYSICAL METHODS IN DETERMINING THE INTERNAL STRUCTURE OF A LARGE LANDFILL,
Warzyn Engineering, Inc., Madison, WI.
For primary bibliographic entry see Field 7B.
W87-01665

BOREHOLE LOGGING TO DELINEATE FRACTURES IN A CONTAMINATED BEDROCK AQUIFER,
NUS Corp., Bedford, MA.
For primary bibliographic entry see Field 7B.
W87-01666

RESISTIVITY-POROSITY CROSS PLOTS FOR DETERMINING IN SITU FORMATION WATER QUALITY - CASE EXAMPLES,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 7B.
W87-01668

FOURTH NATIONAL SYMPOSIUM AND EXPOSITION ON AQUIFER RESTORATION AND GROUND WATER MONITORING.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5G.
W87-01669

ASSESSMENT OF PURGE WELL EFFECTIVENESS FOR AQUIFER DECONTAMINATION,
Geologic Testing Consultants Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5G.
W87-01679

SUBSURFACE ORGANIC RECOVERY AND CONTAMINANT MIGRATION SIMULATION,
For primary bibliographic entry see Field 5G.
W87-01680

TRANSPORT MODELING IN THE RESTORATION OF STRATIFIED AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-01686

MODEL STUDY OF SELECTED MITIGATIVE STRATEGIES TO CONTROL RADIONUCLIDE MIGRATION IN GROUND WATER,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W87-01687

INTERIM STATUS GROUND WATER MONITORING SYSTEM ASSESSMENTS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 7A.
W87-01689

GROUND WATER MONITORING SYSTEM DESIGN IN A COMPLEX GEOLOGIC SETTING,
Conversion Systems, Horsham, PA.
For primary bibliographic entry see Field 7A.
W87-01690

USE OF COMPUTER MODELING TECHNIQUES IN THE DESIGN OF A MONITORING PROGRAM AT A HAZARDOUS WASTE SITE,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5G.
W87-01691

EFFECTS OF WELL-CASING COMPOSITION AND SAMPLING METHOD ON APPARENT QUALITY OF GROUND WATER,
For primary bibliographic entry see Field 8G.
W87-01692

STRADDLE PACKER SAMPLING AND TESTING OF WELLS COMPLETED IN TRIASSIC ROCKS OF PENNSYLVANIA,
Ground Water Associates, Inc., Arlington, MA.
For primary bibliographic entry see Field 5A.
W87-01697

SAMPLING PROCEDURES FOR THE BISCAYNE AQUIFER PROTECTION STUDY,
For primary bibliographic entry see Field 5A.
W87-01698

GROUND WATER MONITORING: A PRACTICAL APPROACH FOR MAJOR UTILITIES,
R. C. Benson, and D. C. Pasley Jr.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 270-278, 14 fig, 2 tab, 10 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Utilities, Florida, Regulations, Water pollution control, Long-term planning, Effluents, Wastewater disposal, Models.

The state of Florida has recently adopted stringent new groundwater regulation. These regulations require facilities discharging effluents to groundwater to provide the State Department of Environmental Regulations with a detailed Ground Water Monitor Plan including sampling and analysis of groundwater at each site. The purpose of the Ground Water Monitor Plan is to determine the hydrogeologic setting of each facility, provide long-term monitoring of discharge zones and develop a three-dimensional description of any contaminant plume within the zone of discharge. Major utilities are significantly affected by these new regulations. Sources of potential groundwater contamination from power plant sites include unlined waste water disposal basins and areas used for temporary storage of fly ash. Accuracy and uncertainty are problems that prevail throughout all aspects of site investigation, data analysis and development of a Ground Water Monitor Plan. A significant improvement can be made by comparing and correlating subsets of commonly used data along with several unique approaches, to provide measures of quality control and to draw synergistically reinforced interpretations. Various sources of data may be used to create a physical conceptual model denoting hydrogeologic site conditions and potential contaminant plumes. A chemical conceptual model can also be created to characterize the wastewater and sediments contained in unlined basins, as well as in near-field and far-field groundwater. Finally, the physical conceptual model and chemical conceptual model are combined to form a refined conceptual model, which describes the three-dimensional site conditions with the required level of accuracy. (See also W87-01669) (Lantz-PTT)
W87-01699

CONVERSION OF RESOURCE EXPLORATION HOLES TO MONITORING WELLS,
Bechtel Energy Corp., Memphis, TN.
For primary bibliographic entry see Field 7A.
W87-01700

EVALUATION OF GROUND WATER CONTAMINATION BY DISSOLVED HYDROCARBONS IN A VARIETY OF HYDROGEOLOGIC SETTINGS,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
R. W. Lewis, and M. A. Penzo.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. 291-299, 5 fig, 4 tab, 4 ref.

Descriptors: *Groundwater pollution, *Hydrocarbons, *Hydrogeology, *Path of pollutants, Oil pollution, Aquifers, Bedrock, Soil types, Flow profiles, Permeability, Pumps, Filtration, Case studies, Water pollution treatment, Plumes.

Many petroleum leaks and spills occur each day that never reach the groundwater aquifer, but are retained in the unsaturated/vadose zone. However, volatile organic compounds (BTX) may be leached from these contaminated soils via meteoric water infiltration. This can result in widespread contamination of the local groundwater aquifer by dissolved organics. In order to define the area of the contamination by dissolved hydrocarbons an assessment of the physical and chemical properties of the aquifer must be performed. Upon reaching the water table, hydrocarbons dissolved in water will have varied characteristics depending on the nature of the aquifer. Monitoring well emplacement must take into account the geohydrology of the aquifer (the soil types, permeability, groundwater flow rates and profiles). Based upon data collected, recovery systems can be designed utilizing pumps, filters and other equipment to treat the water. Two case studies are presented here which exhibit how very small petroleum leakage problems can result in relatively extensive groundwater contamination problems. In the first case, the local hydrologic properties of the aquifer dominated the configurataion and extent of the contaminant plume. In contrast, the fracture pattern and differential hydraulic conductivity of the bedrock, dominated the contaminant migration pattern in Case 2. The analysis of the contaminant plume will also aid in the design and implementation of remedial measures. In Case 1, the interceptor system was regulated to a fairly low pumping rate. This low pumping rate was used to contain the contamination plume, but avoid treating excessive quantities of clean water. In Case 2, the site analysis revealed that the contamination problem was in two discrete fracture zones and not as pervasive as first thought. A containment system was then designed to address both components of contaminant migration and in just the static water table, was generally found to be 5 to 15 feet above the bedrock surface. This data indicates that the till acts as a confining cap producing artesian conditions. (See also W87-01669) (Lantz-PTT)
W87-01702

DETERMINATION OF HYDROCARBON THICKNESSES IN SEDIMENTS USING BOREHOLE DATA,
Engineering Enterprises, Inc., Norman, OK.
R. A. Hall, S. B. Blake, and S. C. Champlin.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 300-304, 7 fig, 1 tab, 2 ref.

Descriptors: *Hydrocarbons, *Groundwater pollution, *Sediments, *Boreholes, *Data interception, Observation wells, Pore size, Formation factor, Water level, Hydrodynamics, Flow profile, Oil pollution.

Correction factors for estimating the thickness of free hydrocarbons in formations can be applied to observation well measurements. The correction factor used is more dependent upon the size of pores in a sand, than on other factors and is therefore more appropriately called a formation factor. To estimate the thickness of free hydrocarbon in a particular formation, it is only necessary to subtract a formation factor from the thickness of hydrocarbons measured in the observation wells. The formation factor varies with pore size and surface tension of the hydrocarbon. The formation factor does not change with thickness of hydrocarbon. Based upon a limited number of box studies it appears that the formation factors can be estimated

for practical use. The experiments were conducted using only static water levels. Under natural conditions, the water levels in shallow aquifers are not static. Data collected in the field and observations of the static models during filling and draining suggests that when water levels are rising, hydrocarbons will flow from the monitoring wells into the formation. As water levels fall, hydrocarbons will migrate into the well. These dynamic conditions cause the value of the correction required to equate the two hydrocarbons thicknesses, to be smaller with rising water levels. This phenomenon is the result of the basic principle that observation wells in water table aquifers react more quickly to changing head conditions than the formation itself. In conclusion, the error in estimating hydrocarbon thicknesses in the formations can be quite large. Corrections for formation grain size can be made, but the total error in hydrocarbon quantity estimates are still the summation of all of the measurement errors. (See also W87-01669) (Lantz-PTT)
W87-01703

MONITORING PETROLEUM SPILLS WITH WELLS: SOME PROBLEMS AND SOLUTIONS,
Engineering Enterprises, Inc., Norman, OK.
S. B. Blake, and R. A. Hall.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 305-310, 6 fig, 8 ref.

Descriptors: *Monitoring, *Oil spills, *Groundwater pollution, *Observation wells, Path of pollutants, Geohydrology, Aquifers, Water pollution control, Mathematical equations, Groundwater movement, Flow profile.

It has been known for quite some time that the thickness of petroleum measured in a monitoring well does not accurately reflect the thickness present in the adjacent formation. In practice, the measured thickness can be several times greater than that in the formation. When trying to evaluate a petroleum spill to determine the total volume of free oil present, the monitoring well error has been a major problem. In unconsolidated formations the process of petroleum migration on the water table, or more appropriately the capillary fringe, can explain the observed thickness of petroleum under various aquifer conditions. An equation has been developed which allows the error in monitoring well measurements to be determined and the actual formation thickness estimated. The equation was developed and tested from column studies currently being conducted. The migration process and the related equation can explain some of the phenomena observed in field measurements, such as: (1) increased measurement error as the formation thickness declines; (2) increased thickness measurements with rapidly falling water levels; (3) long stabilization periods for newly installed observation wells; and (4) API gravity effects on measured oil thickness. The results presented are preliminary and refinements in the findings are expected as experimentation continues. (See also W87-01669) (Lantz-PTT)
W87-01704

DISCRIMINATION BETWEEN REAL AND APPARENT ACCUMULATION OF IMMISCIBLE HYDROCARBONS ON THE WATER TABLE: A THEORETICAL AND EMPIRICAL ANALYSIS,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
P. M. Yaniga, and J. G. Warburton.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 311-315, 4 fig, 6 ref.

Descriptors: *Discrimination analysis, *Groundwater pollution, *Hydrocarbons, *Water table, *Accumulation, *Theoretical analysis, *Empirical analysis, Subsurface mapping, Path of pollutants, Observation wells, Model studies, Hydrodynamics, Aquifers, Plumes.

The accumulation of immiscible hydrocarbon products on the water table can be mapped from observation well data, provided the wells are properly designed and carefully installed. The use of observation wells is a commonly accepted method to define the extent and thickness of a hydrocarbon plume. The interpretation of plume thickness data from the well bore, however, continues to be a point of discussion and some disagreement within the hydrogeologic profession. The exclusive displacement model is one of the more widely accepted representations of the difference between the apparent plume thickness, yielded by readings from the well bore, and the real plume thickness that exists in the surrounding formation. Generally explained, this model holds that the water level in the well bore is displaced downward by the accumulation of immiscible hydrocarbons. The authors maintain, however, that empirical evidence and the fundamental physics of fluids and porous media argue against this model in unconsolidated sandy aquifers. They post an alternate model, iterated with data from an unconsolidated water table aquifer, that relies on the differential capillarity and wetability of the formation materials, for hydrocarbons vs. water. This model suggests that the water level in a well bore is not displaced downward by the accumulation of hydrocarbons. Rather, the water level evident in the well bore represents the true level of the water table within the surrounding aquifer, and the apparent plume thickness in the well bore results solely from the accumulation of hydrocarbons above the water table, with little possibility for downward displacement of water within the well bore or the surrounding formation. (See also W87-01669) (Author's abstract)
W87-01705

IDENTIFICATION AND REMOVAL OF HYDROCARBONS FROM UNCONSOLIDATED SEDIMENTS AFFECTED BY TIDAL FLUCTUATIONS,
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 5A.
W87-01706

PETROLEUM PRODUCT RECOVERY IN COASTAL FACILITIES UTILIZING TIDAL FLUCTUATIONS,
Haley and Aldrich, Inc., Cambridge, MA.
J. L. Kennedy, W. E. Stimpson, and H. E. Phillips.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 323-327, 8 fig.

Descriptors: *Oil spills, *Oil recovery, *Coastal plains, *Tides, Subsurface mapping, Geohydrology, Pumps, Harbors, Cleanup operations, Organic soils, Storage tanks, Aquifers, Water table, Skimmers.

This paper documents the importance of identifying the hydrogeology of a hydrocarbon spill site prior to establishing a recovery program. While obtaining subsurface information for designing an emergency spill-recovery system, free product was discovered beneath an oil storage facility located adjacent to a harbor. A substantial portion of the site is underlain by compressible organic soils, and concern for potential settlement of the facilities resulting from increased pumping associated with the recovery operation led to the conduct of a detailed subsurface exploration program to identify the site geology. The study revealed the presence of a shallow and deep aquifer separated for the most part by the impermeable organic soil layer. In the vicinity of the storage tanks, the impermeable soil had been removed during construction and the two aquifers were in direct hydraulic connection, and the lost product was floating on the water table in the upper aquifer. In the area where the soil layer was removed, the upper water table exhibited tidal response. It was also noted that the product thickness in wells increased and decreased with changing tide level. Based on an understanding of the hydrogeology of the site, modifications were made in the recovery operations. Use of the suppression pumps was terminated and the naturally occurring tidal-induced fluctuation in the water table was utilized to draw product into wells where it was skimmed off. To date, more than half of the estimated quantity of lost product has been recovered using this modified recovery system. (See also W87-01669) (Lantz-PTT)
W87-01707

HYDROGEOLOGIC SITE ASSESSMENT VS. REALITY AT A CHEMICAL PLANT,
Roux Associates, Inc., Halesite, NY.
J. M. DeMartinis, and P. H. Roux.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 349-355, 5 fig, 2 ref.

Descriptors: *Geohydrology, *Groundwater pollution, *Chemical wastes, *Fate of pollutants, Domestic wells, Path of pollutants, Organic compounds, Aquifers, Monitoring, Observation wells, Water pollution sources, Groundwater movement.

A comprehensive hydrogeologic investigation was conducted at the site of a chemical plant, where previous studies detected organic compounds at low ppm concentrations in a local domestic well. The stepwise approach utilized determined: (1) the source(s) of compounds in the domestic well; (2) the extent of the organic compounds in the shallow aquifer; and (3) if contaminated groundwater from the shallow aquifer was flowing into deeper aquifers. Thirty-two monitoring wells were installed and sampled in a logical sequence to map groundwater flow and quality. An electrical earth resistivity survey was conducted to demonstrate that the aquitard protecting the deeper aquifers is continuous. The source of the compounds was determined to be the unlined lagoons and a .7-mile long by .6-mile wide plume was delineated in the unsuspected northeast direction from the plant. Groundwater flow in the area was found to be controlled by subsurface geologic conditions rather than the more common recharge-discharge relationships assumed in the initial site assessment. (See also W87-01669) (Lantz-PTT)
W87-01710

FIELD MONITORING OF THE ADAMS, MASSACHUSETTS LANDFILL LEACHATE PLUME,
R. R. Noss, and E. T. Johnson.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 356-362, 9 fig, 1 tab, 8 ref. Massachusetts Division of Water Pollution Control, Contract No. 80-32.

Descriptors: *Field tests, *Groundwater pollution, *Monitoring, *Adams, *Massachusetts, *Landfills, *Leachates, Plumes, Groundwater pollution, Mounding, Seeps, Groundwater movement, Observations wells, Piezometers, Boreholes.

On May 19, 1980, the EPA promulgated regulations relative to the installation of monitoring wells at sanitary landfills. In general, the regulations required the installation of one upgradient and three downgradient wells in the uppermost aquifer adjacent to the land disposal site. While the intent of the Resource Conservation and Recovery Act (RCRA) mandate is clear, this Adams landfill study highlights possible shortcomings of the regulations. Choosing data from various combinations of any three piezometers in the well field led to differing interpretations of plume shape, size, direction of movement and effect on the surrounding area. While the installation of a monitoring network as large as the one at Adams would be an unnecessary requirement in most cases, requiring multiple piezometers in the three required downgradient wells would be a relatively small price to pay for the additional data provided. Beside the obvious increase in the number of sampling locations, additional piezometers in a single borehole would provide an extra dimension for use in modeling studies, more accurate groundwater analysis as a result of shorter screen lengths and a means of determining vertical and horizontal flow gradients. (Lantz-PTT)
W87-01711

MONITORING NETWORKS AND HYDROLOGIC BUDGET FOR EVALUATING A LEACHATE CONTROL SYSTEM IN A LANDFILL IN CALIFORNIA,
California State Univ., Fullerton. Dept. of Geology.
P. K. Saint, G. B. Nunnelley, and W. E. Collord.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 363-367, 6 fig, 2 tab, 7 ref.

Descriptors: *Monitoring, *Groundwater pollution, *Hydrologic budget, *Networks, *Leachates, *Water pollution control, *Landfills, *California, Calveras, Liners, Geologic fractures, Groundwater movement, Flow profiles, Geohydrology, Bedrock.

The Red Hill Landfill A, Calveras, California, with an improper liner overlying fracture phyllites, is a major source of leachates escaping from the site. The foliations, joints and fractures provide secondary porosity in the bedrock. A stereographic analysis of the plunge direction of the intersecting joint planes, suggests preferred movement of leachates and groundwater toward the west. Similarity of chemical analysis of the groundwater suggests continuity of hydrologic connections between Sites A and B. This has also been confirmed by geological, hydrological and geophysical (not reported here) data. Leachate controls would require expansion of the present impermeable barriers into the fractured bedrock, probably in the form of grout curtains. The present monitoring network has to be expanded to include bedrock wells for evaluating the effectiveness of the leachate containment systems. (See also W87-01669) (Lantz-PTT)
W87-01712

ORGANIC CONTAMINANT CONTROL IN A GULF COAST AQUIFER,
For primary bibliographic entry see Field 5G.
W87-01713

ON-SITE CONTAINMENT OF PCB-CONTAMINATED SOILS AT AEROVOX INC., NEW BEDFORD, MASSACHUSETTS,
J. J. Gushue, and R. S. Cummings.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 375-385, 8 fig, 5 tab, 4 ref.

Descriptors: *Polychlorinated biphenyls, *Soil contamination, *New Bedford, *Massachusetts, Regulations, Standards, Groundwater pollution, Monitoring, Water sampling, Waste treatment, Containment systems, Cutoffs, Geohydrology, Concrete, Asphalt, Tides, Maintenance.

A remedial investigation and design project completed for the Aerovox Inc. plant site in New Bedford, Massachusetts is summarized. The evaluation was prepared for Aerovox by GHR Engineering Corp. in accordance with consent agreements entered into by Aerovox in May 1982 with the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Quality Engineering (DEQE). In October 1982 the results of soil and groundwater sampling and analysis conducted at the Aerovox site were provided to EPA and DEQE. An evaluation of remedial alternatives for the site, based on the previous sampling and analysis program, was completed in February 1983. On the basis of the technical, economic and environmental considerations discussed in the preceding sections, the final remedial action plan for the Aerovox property included both: (1) Capping of the contaminated soil areas by paving with hydraulic asphalt concrete (HAC); and (2) Installation of steel sheet piling cutoff wall to serve as a vertical barrier to groundwater and tidal flow into and out of the contaminated soils. In September 1983, the necessary governmental approvals for on-site containment by means of a steel sheet piling cutoff wall/hydraulic asphalt concrete cap system were obtained. Construction of the containment system began in October 1983 and was to be completed in June 1984. The primary maintenance requirements for the surface cap are to: (1) minimize vehicular traffic on the area, and (2) apply a seal coating if needed to revitalize the surface and fill any cracks that may have formed. Periodic inspection of the surface will reveal the need for surface sealing or any other measures to maintain the integrity of the cap. In terms of site monitoring requirements, the water table elevation within the perched groundwater system will be monitored to determine the effectiveness of the vertical cutoff wall and surface cap. Initially, water level monitoring over an extended period, as done during this study, will be used to evaluate groundwater levels under normal and extreme tidal conditions. Subsequently, water level readings will be taken only periodically (quarterly) to maintain a continuous review of system performance. (See also W87-01669) (Lantz-PTT)
W87-01714

IMPACT AND RECOVERY OF CHROMIUM WASTE LEAKED BENEATH AN INDUSTRIAL PLANT,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5G.
W87-01716

COMPARATIVE TOXICOLOGY AND PHARMACOLOGY OF CHLOROPHENOLS: STUDIES ON THE GRASS SHRIMP, PALAEMONETES PUGIO,
University of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-01720

FACTORS AFFECTING TRACE METAL UPTAKE AND TOXICITY TO ESTUARINE ORGANISMS: I. ENVIRONMENTAL PARAMETERS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
For primary bibliographic entry see Field 5C.
W87-01723

FACTORS AFFECTING TRACE METAL UPTAKE AND TOXICITY TO ESTUARINE ORGANISMS: II. CELLULAR MECHANISMS,
National Inst. of Environmental Health Sciences, Research Triangle Park, NC. Lab. of Organ Function and Toxicology.
For primary bibliographic entry see Field 5C.
W87-01724

APPLICATION OF BIOCHEMICAL AND PHYSIOLOGICAL RESPONSES TO WATER QUALITY MONITORING,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5C.
W87-01728

MERCURY IN MUSSELS OF BELLINGHAM BAY, WASHINGTON (U.S.A.): THE OCCURRENCE OF MERCURY-BINDING PROTEINS,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
G. Roesijadi, A. S. Drum, and J. R. Bridge.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 357-376, 4 fig, 6 tab, 32 ref. DOE Contract No. EY-76-C-06-1830.

Descriptors: *Path of pollutants, *Mercury, *Mussels, *Bellingham Bay, *Washington, *Proteins, Chemical analysis, Tissue analysis, Gills, Digestive glands, Fate of pollutants, Carbon radioisotopes, Bioaccumulation.

Laboratory experiments demonstrated the existence of metallothionein-like, low molecular weight, mercury-binding proteins in the marine mussel Mytilus edulis. Relatively large quantities of mercury were associated with such proteins in the gills and digestive glands. 14-C incorporation indicated induction of the protein in gills, but not in the digestive glands, where mercury may have bound to existing metal-binding proteins. Short-term incorporation of mercury occurred primarily in the gills. The induction of mercury-binding proteins in gills may have facilitated detoxification of mercury at the site of uptake. Generally, mercury in the mussels of Bellingham Bay decreased from 1970 to 1978, the collection date for this study. Mercury levels although low, were approximately three times higher than those from uncontaminated areas. Mercury associated with the mercury-binding protein of gills and digestive glands of Bellingham Bay mussels was low, and reflected the concentrations measured in the whole tissues. (See also W87-01717) (Lantz-PTT)
W87-01732

EXCRETION OF AROMATIC HYDROCARBONS AND THEIR METABOLITES BY FRESHWATER AND SEAWATER DOLLY VARDEN CHAR,
California State Univ., Chico. Dept. of Biological Science.
R. E. Thomas, and S. D. Rice.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 425-448, 2 fig, 5 tab, 35 ref.

Descriptors: *Water pollution effects, *Excretion, *Hydrocarbons, *Aromatic compounds, *Metabolism, *Char, Marine environment, Fresh Water, Fate of pollutants, Carbon radioisotopes, Gills, Tissue analysis, Urine, Gall bladder, Napthalene, Fish, Chemical analysis, Water pollution effects.

The contamination of aquatic animals by petroleum hydrocarbons was studied by determining: (1) the major excretory routes of 14-C napthalene, 14-C toluene, and their metabolites from Dolly Varden char (Salvelinus malma); (2) the percentage of carbon-14 metabolites of 14-C toluene and 14-C napthalene excreted by each major excretory pathway; (3) the relationship between retention and excretion of 14-C toluene, 14-C napthalene, their metabolites; and (4) whether environmental salinity affected any of these parameters. The gills were the most important pathway for excretion of carbon-14 from 14-C naphthalene. Most of the carbon-14 excreted by the gills was still attached to the parent compound. About 10% of the excreted carbon-14 appeared in the cloacal chamber, mostly as metabolites. Less than 1% of the total carbon-14 was excreted in the urine, predominantly as metabolites. Tissues retained a significant amount of carbon-14 at 24 hr. Although muscle contained large amounts of carbon-14 because of its mass, the gall bladder had the highest specific activity. The brain also retained significant quantities of carbon-14. Although more 14-C toluene was excreted and metabolized than 14-C naphthalene, more 14-C naphthalene was retained in the tissues. A lower percentage of the carbon-14 was recovered in 14-C naphthalene metabolites than in 14-C toluene metabolites. Seawater and freshwater Dolly Varden char excreted similar amounts of carbon-14. However, the percentage of metabolites in the excretions and tissues of seawater fish was lower than the percentage of metabolites in excretions and tissues of freshwater fish. (See also W87-01717) (Lantz-PTT)
W87-01735

ECOLOGICAL PERSPECTIVE OF THE EFFECTS OF MONOCYCLIC AROMATIC HYDROCARBONS ON FISHES,
National Marine Fisheries Service, Tiburon, CA. Tiburon Lab.
For primary bibliographic entry see Field 5C.
W87-01738

REGIONAL DISTRIBUTION OF SOME WATER QUALITY VARIABLES IN FINNISH COASTAL WATERS,
H. Pitkanen.
National Board of Waters, Finland. Water Research Institute Publication No. 62, 1985. p 105-

120, 8 fig.

Descriptors: *Water quality, *Finland, *Coastal waters, Oxygen, Nitrogen, Phosphorus, Silicates, Iron, Gulf of Bothia, Inorganic compounds, Water pollution effects, Chemical analysis, Baltic Sea, Effluents.

Regional distribution of oxygen, phosphorus, nitrogen, silicate and iron concentrations in Finnish coastal waters outside the direct effect of rivers and waste waters were studied. The levels of concentrations in the late 1960's were compared with those of the late 1970's. The distribution of concentrations was found to be dependent in the first place on the water quality in the open sea. The effects of rivers and waste water effluents on the concentrations were modified by the extent of loading, the morphometry of the coastal region and ice coverage in winter. Total nitrogen concentrations increased between the two studied periods, and an increase in total phosphorus was noticed in the late summer samples. In the coastal waters of the Gulf of Bothnia the level of total phosphorus somewhat decreased according to the winter data of these two periods. The ratio of inorganic nitrogen to inorganic phosphorus decreased elsewhere but increased in the coastal waters of the Bothnian Bay. These changes resulted mainly from variation in the Baltic Sea hydrography but to a minor extent also from changes in loading from the land. (Author's abstract)
W87-01744

MERCURY IN SNOW COVER AND RAINFALL IN FINLAND 1983-1984,
S. Rekolainen, M. Verta, and O. Jarvinen.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 1-10, 4 fig, 3 tab, 37 ref.

Descriptors: *Mercury, *Path of pollutants, *Snow cover, *Rain, *Finland, Deposition, Spatial distribution, Urban areas, Rural areas.

Mercury contents were measured in the snow cover and in 17 different rainfall events in Finland during 1983-1984. The mercury concentrations of snow ranged between <10 and 50 nanograms/L in rural areas. In urban and industrial sites, concentrations of up to 90 nanograms/L mercury were measured in snow. In rain water, mercury concentrations ranged between <10 and 30 nanograms/L. On the basis of the concentrations of mercury in snow cover the total deposition rate was estimated to be 3 micrograms/sq m/yr in Finland. The deposition and the concentration of mercury was higher in southern Finland than in the north and also in urban areas, indicating the influence of anthropogenic sources on airborne mercury. (Author's abstract)
W87-01745

EFFECT OF AIRBORNE MERCURY AND PEATLAND DRAINAGE ON SEDIMENT MERCURY CONTENTS IN SOME FINNISH FOREST LAKES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
S. Rekolainen, M. Verta, and A. Liehu.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 11-20, 7 fig, 2 tab, 29 ref.

Descriptors: *Mercury, *Water pollution sources, *Path of pollutants, *Peat soils, *Drainage, *Lake sediments, *Finland, Organic matter, Hydrogen ion concentration, Forests, Forest management, Runoff, Leaching.

Mercury contents were analyzed in sediment cores taken from 13 lakes in southern, central and northern Finland. In lakes in southern Finland with no drainage operations being performed in their catchment areas, a distinct increase in mercury concentrations was observed in recent sediments. In northern Finland only a slight or zero increase was recorded. According to Pb-210 dating the most remarkable increase began in the years 1920-1930. The increase was concluded to mainly a result of increased atmospheric mercury deposition. The sediment mercury content correlated significantly with the organic matter content of the sediment and with the pH of the water. Intensive peatland drainage of the catchment area caused the decrease in mercury content in the topmost sediment layers in some lakes. This was probably due to the higher content of leached allochthonous material of the total sedimenting material. The mercury accumulation rate ranged from 25-50 micrograms/sq m/yr in lakes with undisturbed or only slightly disturbed runoff areas and reached 370 micrograms/sq m/yr in a lake affected by intensive drainage operations. (Author's abstract)
W87-01746

ORIGIN AND LEVEL OF MERCURY IN FINNISH FOREST LAKES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
M. Verta, S. Rekolainen, J. Mannio, and K. Surma-Aho.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 21-31, 5 fig, 2 tab, 42 ref.

Descriptors: *Mercury, *Water pollution sources, *Methylation, *Lakes, *Pike, *Roach, *Finland, *Path of pollutants, *Air pollution, *Forests, Hydrograph analysis, Lake morphology, Correlation analysis, Regression analysis, Water quality, Organic matter, Lake sediments.

Mercury concentrations of pike in Finnish lakes affected by no known mercury pollution were analyzed in 1980-1983. The effect of water quality, hydrographic and morphometric parameters, land use, mercury content of the diet and mercury content of sediments on the mercury content of pike were studied on the basis of correlation analysis and stepwise regression analysis. The roach mercury content, the terrestrial catchment area/lake volume ratio and water quality parameters describing organic matter content in the water all correlated positively with pike mercury contents, whereas the areal percentage of lakes in the catchment area was negatively correlated. Slowly growing pike had higher mercury concentrations in relation to the mercury content of the diet than did rapidly growing pike. As much as 57% of the mercury variation in 1 kg pike from different lakes could be explained by the morphometric, chemical and biological variables studied. The mercury level in pike in southern and central Finland was estimated to have increased during the past 100 years by a factor of about 2. The most probable reason for this was concluded to be an increased load of atmospheric mercury. (Author's abstract)
W87-01747

EFFECT OF WATER QUALITY ON THE MERCURY CONCENTRATION OF NORTHERN PIKE (ESOX LUCIUS, L.) IN FINNISH FOREST LAKES AND RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
J. Mannio, M. Verta, P. Kortelainen, and S. Rekolainen.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 32-43, 5 fig, 1 tab, 54 ref.

Descriptors: *Water quality, *Mercury, *Pike, *Finland, *Lakes, *Reservoirs, *Path of pollutants, Ostrobothnia, Regression analysis, Decomposing organic matter, Hydrogen ion concentration, Nutrients, Drainage area, Chemical properties, Iron, Conductivity, Alkalinity, Calcium, Suspended solids.

Correlations between water quality parameters and the total mercury concentration in northern pike (Esox lucius L.) were studied in 35 forest lakes and 10 reservoirs located mainly in Central Finland and Ostrobothnia. The concentrations of mercury in pike (750 g) varied from 0.21 to 1.02 mg/kg in lakes and from 0.42 to 1.80 mg/kg in reservoirs. All estimates of the content of humic matter in water correlated positively ($P<0.001$) with the mercury content in pike. Water pH and nutrients were related to the humic matter. In multiple regression analysis other water quality parameters could not explain essentially more the variation of mercury contents in pike. The results support observations that the total input of humic matter from the drainage area contributes to the high concentrations of mercury in pike in headwater lakes. In young reservoirs the dissolved organic matter from inundated soil seems to be the main source of mercury. (Smith-PTT)
W87-01748

CAUSES OF INCREASED FISH MERCURY LEVELS IN FINNISH RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
M. Verta, S. Rekolainen, and K. Kinnunen.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 44-58, 7 fig, 6 tab, 29 ref.

Descriptors: *Mercury, *Path of pollutants, *Water pollution sources, *Fish, *Pike, *Reservoirs, *Finland, Organic matter, Chemical oxygen demand, Manganese, Hydrogen ion concentration, Statistical models, Zooplankton, Clay soils, Sediments, Regression analysis, Lake sediments, Water quality.

Elevated fish mercury levels were found in Finnish reservoirs flooded for hydroelectric and flood control purposes. The highest levels (up to 4.1 mg/kg in pike, Esox lucius L.) were observed in young heavily regulated reservoirs with a high organic matter content in the water. In reservoirs flooded on old lake bottoms or on clayish soils much lower fish mercury contents were recorded. In nine of the 20 reservoirs studied the mean concentration of mercury in at least one fish species exceeded 1.0 mg/kg, which is the highest level for edible fish in Finland. Statistical models for predicting mercury levels in pike based on the age of the reservoir, the extent of regulation, organic matter content (COD (Mn)) and pH gave satisfactory results. Laboratory experiments as well as mercury concentrations measured in water and zooplankton in a newly built reservoir indicated that organic substances acted as mercury carriers from the soil into the water phase and biota. (Smith-PTT)
W87-01749

ORGANIC AND INORGANIC MERCURY IN THE FOOD CHAIN OF SOME LAKES AND RESERVOIRS IN FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
K. Surma-Aho, J. Paasivirta, S. Rekolainen, and M. Verta.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 59-71, 6 fig, 11 tab, 63 ref.

Descriptors: *Methyl mercury, *Path of pollutants, *Food chains, *Lakes, *Reservoirs, *Organic matter, *Finland, Benthic fauna, Zooplankton, Fish, Waterford, Settleable solids, Pike, Decomposing organic matter, Lake sediments.

Contents of organic and inorganic mercury in food chain specimens, as well as sedimentation in two natural Finnish lakes and three impounded reservoirs, were studied. The proportion of organic mercury to total mercury, varied in individual specimens from 32.7 to 100%. Sedimentation (settleable solid) with very high contents of organic matter had ratios of organic to total mercury ranging from 2.4 to 87.3%. These variations were similar in each of five water ecosystems studied. Benthic invertebrates had higher ratios of organic to total mercury than reported earlier. Total mercury concentrations in fish, zoobenthos and zooplankton of young impounded reservoirs were significantly higher than those of natural lakes. It is suggested that humic materials transfer mercury to the water and then into the food chain. (Smith-PTT)
W87-01750

SELENIUM AND MERCURY CONTENTS IN NORTHERN PIKE (ESOX LUCIUS, L.) OF FINNISH MAN-MADE AND NATURAL LAKES,

J. Leskinen, O. V. Lindqvist, J. Lehto, and P. Koivistoinen.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 72-79, 3 fig, 2 tab, 30 ref.

Descriptors: *Selenium, *Mercury, *Pike, *Lakes, *Artificial lakes, *Finland, *Bioaccumulation, Lake Seinajarvi, Lake Kalajarvi, Aquatic ecosystems, Lake sediments, Biochemistry.

The selenium contents in liver and muscle of 107 Northern pike from Finnish man-made and natural lakes were analyzed and the relationship between selenium and mercury was investigated. The mean selenium concentrations in liver and muscle in man-made lakes were 1.07 mg/kg and 0.14 mg/kg, respectively and in natural lakes 1.11 and 0.30 mg/kg. The selenium concentration of liver or muscle did not correlate with the weight, age, growth rate or dry matter content of muscle or with the water quality data of lakes or the estimated selenium content of the drainage basin. The selenium content was the highest (1.84 mg/kg) in the livers of pikes from Lake Seinajarvi, in contrast to the percentage of methyl mercury in the livers, which was the lowest (74% of total mercury, compared with about 90% in other lakes). The selenium content did not explain the mercury contents in pike within the individual lakes, although in man-made lakes the selenium levels were lower and the mercury levels higher than in natural lakes. For both selenium and mercury concentrations, the muscle:liver ratio was lower in man-made lakes (i.e., Lake Kalajarvi, 0.14:1 and 0.87:1) than in natural lakes (0.30:1 and 1.44:1). Differences between the levels and distributions of selenium and mercury in pikes of man-made and natural lakes could be partly due to interactions between these elements. (Smith-PTT)
W87-01751

CHARACTERISTICS OF THE ALLOCHTHONOUS ORGANIC MATTER IN FINNISH FOREST LAKES AND RESERVOIRS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
P. Kortelainen, J. Mannio, and V. Pennanen.
National Board of Waters, Finland. Water Research Institute Publication No. 65, 1986. p 88-97, 7 fig, 4 tab, 12 ref.

Descriptors: *Organic matter, *Lakes, *Reservoirs, *Finland, Total organic carbon, Dissolved organic carbon, Chemical oxygen demand, Optical properties, Color, Fluorescence, Nitrogen, Phosphorus, Iron, Chromatography, Absorption, Chemical properties.

The concentration of organic matter in 36 forest lakes and 10 reservoirs was measured by total organic carbon (TOC), dissolved organic carbon (DOC), chemical oxygen demand (COD sub Mn) and by optical measurements: color, absorbance (A420 and A254) and fluorescence. The water samples were taken during winter stratification and autumn overturn. The amount of organic matter was on average greater in the reservoirs than in the lakes. In both data sets organic matter correlated positively with the concentrations of total nitrogen, total phosphorus and total iron. The organic matter of the water samples was fractionated into low molecular weight (LMW) and high molecular weight (HMW) fractions by gel chromatography. The organic matter of lakes consisted of more homogenous humus, of which the LMW fraction was proportionally higher than in the reservoirs. When low concentrations of organic matter were observed the LMW fraction dominated in the lakes, whereas the proportional amount of HMW fraction was high in the reservoirs. The amount of organic matter was highest in the youngest reservoirs, where the proportion of LMW fraction was also high. This implies that the dissolved organic matter is released effectively from recently inundated soil and the formation of HMW fraction by the reaction of iron and LMW fractions is rather ineffective during the first few years after impoundment. (Smith-PTT)
W87-01753

SOLUTE-LOADING SOURCES IN THE DIRTY DEVIL RIVER BASIN, UTAH,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. L. Rittmaster, and D. K. Mueller.
Available from the National Technical Information Service, Springfield, VA. 22161. Report REC-ERC-85-5, May 1985. 19 p, 2 fig, 7 tab, 17 ref, append.

Descriptors: *Solute transport, *Water pollution sources, *Dirty Devil River, *Utah, Muddy Creek, Dissolved solids, Salinity, Sediments, Poison Creek, Mathematical analysis, Water analysis, Path of pollutants, Gypsum, Feldspar, Sulfides, Oxides.

Water management planning for salinity control is often based on the assumption that a reduction in the solute-loading level is conserved downstream. This assumption was tested using field data from the Dirty Devil River Basin, in southeastern Utah, and in a batch (laboratory) study of water and sediment samples. The study was designed to identify the sources of solute loading in the basin and to determine that differences in solute loading from channel sediments, in response to variations in initial water quality. A primary goal was to determine the present extent of gypsum dissolution from channel material, and its potential change if agricultural salinity-control measures are instituted. The laboratory batch study demonstrated that channel sediments have essentially no impact on the solute load of the stream, regardless of the initial salinity of the stream. After initial contact with the sediment (0.5 h), the total dissolved solids (TDS) of low-salinity water from Muddy Creek above Emery increased by 9 mg/L (3%) with 5 days additional contact. The TDS of high-salinity water from the Dirty Devil River at Poison Spring increased by 6 mg/L (1%). Neither increase is considered significant. According to WATEQF calculations, both contact solutions were undersaturated with respect to gypsum and were thus capable of dissolving gypsum in the channel sediments. BALANCE mass-transfer calculations indicated very slight dissolution of gypsum to account for solute changes in waters between 0.5 and 120 of contact. However, mineralogic study showed little or no gypsum. The small solute increases between 0.5 and 20 hours were difficult to correlate with sediment analyses. Additional data would be required to determine the importance of reactions such as the dissolution of feldspars and the oxidation of sulfides and oxides. (Lantz-PTT)
W87-01758

5C. Effects Of Pollution

INTERMITTENT BIOLOGICAL TREATMENT OF HAZARDOUS WASTES,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-00834

CONSIDERATION OF GROUNDWATER POLLUTANT REACTIONS IN MATHEMATICAL MODELING,
Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-00849

USE OF SHORT-TERM TESTS TO EVALUATE THE POTENTIAL TOXICITY OF A TEXTILE WASTE IN A LAND APPLICATION SYSTEM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W87-00869

DUWAMISH WATERWAY CAPPING DEMONSTRATION PROJECT: ENGINEERING ANALYSIS AND RESULTS OF PHYSICAL MONITORING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W87-00879

HISTOPATHOLOGICAL EFFECTS OF BLACK ROCK HARBOR DREDGED MATERIAL ON MARINE ORGANISMS: A LABORATORY INVESTIGATION,
Environmental Research Lab., Narragansett, RI.
P. P. Yevich, C. A. Yevich, K. J. Scott, M. Redmond, and D. Black.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA 168126, A05 in paper copy, A01 in microfiche. Technical Report D-86-1, February 1986. Final Report. 72 p, 12 fig, 14 tab, 21 ref.

Descriptors: *Pathology, *Water pollution effects, *Black Rock Harbor, *Dredging, Environmental effects, Tissue analysis, Mollusks, Amphipods, Polychaetes, Rhode Island.

Histopathology studies were conducted on tissues representing the major organ systems of several marine organisms exposed in the laboratory to Black Rock Harbor dredged material. These studies examined the applicability of these procedures for measuring biological effects of dredged material and the variability and reproducibility of the methodology. Female reproductive tract changes in the filter feeding bivalve mollusks, included degeneration of ova and loss of nuclei, cytoplasm, and vitelline membrane. Cardiovascular changes in this species were characterized by pedunculated growths from the auricle, ventricle, and pericardial wall. There were well-defined patterns of histological changes in some amphipods, characterized by necrosis of gill epithelium and lamellae, loss of normal gill architecture, and changes in the mucous tube glands. The polychaete annelids studied developed histopathological changes in the parapodial musculature, metaplasia of the epidermis, and degeneration of mucous cells. The responses were very consistent between replicated experiments both qualitatively and quantitatively. The results from these studies indicate that histological changes can be used to measure the effects of dredged material and that the methodology, while inherently subjective, is reproducible when done by the same investigator. The potential problem with reproducibility of this technique lies with differences in the subjective nature of interpretation between different investigators. (Lantz-PTT)
W87-00881

ANAEROBIC BIOGEOCHEMICAL PROCESSES IN THE SUBSURFACE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W87-00884

HYDROPHYSICAL INTERACTIONS OF ORGANIC CHEMICALS WITH GEOLOGICAL MATERIALS: REVIEW OF INTERACTIONS OF ORGANIC CHEMICALS IN THE SUBSURFACE WITH EMPHASIS ON CLAYS AND LOW PERMEABILITY SEDIMENTARY ROCKS.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W87-00885

THRESHOLDS FOR ACIDIFICATION: A FRAMEWORK FOR POLICY AND RESEARCH,
Environmental Defense Fund, New York.
For primary bibliographic entry see Field 5B.
W87-00890

EXPECTED BRINE CHEMISTRY IN A NUCLEAR WASTE REPOSITORY IN SALT,
Weston Consultants, Rockville, MD.
S. V. Panno, and K. V. Czycinski.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 201-209, 6 fig, 1 tab, 45 ref.

Descriptors: *Radioactive waste disposal, *Salt deposits, *Path of pollutants, *Brines, *Chemical analysis, *Radioactive wastes, *Salts, Thermal properties, Gamma radiation, Radioactivity effects, Chemical reactions, Deionization.

A high-level nuclear waste repository in a bedded or domed salt deposit will result in a localized zone of elevated temperatures (up to 250 C), high levels of gamma radiation (up to 4,000 rad/hr), and radiation-damaged salt around and near the waste. The chemical effects of gamma radiation on brine have been known for some time; major reaction products include H2, O2 and possibly ClO3(-). The physical effects of radiation on rock salt are also well known and include the formation of F-centers, colloidal sodium and displaced chloride ions. The likely significance of these conditions include the acceleration of both waste container corrosion and waste form dissolution, and uncertainties in radionuclide solubilities and speciation. Significant changes in brine chemistry result from the interaction of water with irradiated rock salt and the irradiation of brine/salt mixtures. Brines made from irradiated rock salt and deionized water increase in alkalinity in a manner similar to that of F-center and colloidal sodium growth (probably due to the formation of NaOH). Irradiation of salt/brine mixtures generates acidic brines (as low as pH 3.5), which may be attributable to the formation of HCl. While the chemical character of the brines in a salt repository is still uncertain, some qualitative assessments may be made based on the foregoing results. Anoxic brines initially within or entering radiation fields at an early time will become oxic due to radiolysis effects and possibly acidic due to salt/brine interactions during irradiation. Brines later migrating toward waste containers up thermal gradients by means of dissolution/diffusion mechanism, will dissolve radiation-damaged salt and form oxic, alkaline brines. (See also W87-00892) (Lantz-PTT)
W87-00904

INTERACTIONS OF ACIDIC SOLUTIONS WITH SEDIMENTS: A CASE STUDY,
Battelle Pacific Northwest Labs., Richland, WA.
S. R. Peterson, R. J. Servne, A. R. Felmy, R. L. Erickson, and K. M. Krupka.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 211-220, 4 fig, 3 tab, 38 ref.

Descriptors: *Path of pollutants, *Uranium wastes, *Leaching, *Acidic water, *Acids, *Sediments, *Chemical reactions, Model studies, Case studies, Geochemistry, Acid rain, Wyoming, Equilibrium, Computer models, Chemical analysis.

A methodology is presented for investigating the chemical interactions of acidic solutions with sediments. This approach illustrates how geochemical modeling can be used, in parallel with characterization data for sediments from field and laboratory experiments, to derive a composite description of the solution/sediment interactions. The MINTEQ geochemical computer code was used to predict solid-phase reactions that might occur when acidic solutions contact neutral sediments, which, in turn, may control the concentrations of certain dissolved components. Results of X-ray diffraction analysis of laboratory samples of sediments that have been contacted with acidic uranium mill tailings solutions suggest gypsum and jarosite precipitated. These same mineralogical changes were identified in sediment samples collected from a drained uranium mill evaporation pond (Lucky Mc mine in Wyoming) with a 10-year history of acid attack. Geochemical modeling predicted that these same phases and several amorphous solids not identifiable by X-ray diffraction should have precipitated in the contracted sediments. An equilibrium conceptual model consisting of an assemblage of minerals and amorphous solid phases was then developed to represent a sediment column through which uranium mill tailings solutions were percolated. The MINTEQ code was used to predict effluent solution concentrations resulting from the reactions of the tailings solution with the assemblage of solid phases in the conceptual model. The modeling predictions were compared to the measured column effluent concentrations, and hypotheses were formed as to the probable mechanisms controlling the migration of selected contaminants. The conceptual model successfully predicted the concentrations of several of the macro-constituents (e.g., Ca, SO4, Al, Fe and Mn), but was not successful in modeling the concentrations of trace elements. The lack of success in predicting the observed trace metal concentrations suggests that other mechanisms, such as adsorption, must be included in future models. The geochemical modeling methodology coupled with the laboratory and field studies should be applicable to a variety of waste disposal problems. (See also W87-00892) (Author's abstract)
W87-00905

REVIEW OF MICROBIAL INFLUENCES ON THE EVOLUTION OF GROUND WATER CHEMISTRY WITH SOME PRACTICAL APPLICATIONS FROM COAL MINE RECLAMATION STUDIES IN ALBERTA,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
P. M. Wallis, and T. I. Ladd.
IN: First Canadian/American Conference on Hydrogeology: Practical Applications of Ground Water Geochemistry, June 22-26, 1984, Banff, Alberta. 1985. p 293-305, 5 fig, 4 tab, 63 ref.

Descriptors: *Groundwater chemistry, *Microorganisms, *Coal mines, *Reclamation, *Alberta, Minerals, Carbon dioxide, Hydrogen ion concentration, Organic compounds, Microbial degradation, Marmot basin, Oxygen, Carbonates.

Microorganisms influence the evolution of groundwater chemistry mainly by (1) attacking minerals directly, (2) releasing carbon dioxide that can change pH, and (3) actively removing dissolved nutrients and oxygen. Minerals such as FeS2 can be oxidized to ferric iron, sulfate, and sometimes acid by autotrophic bacteria such as Thiobacillus spp. Analogous reactions are known for minerals containing manganese. Under anoxic conditions, sulfate can be reduced back to sulfide by sulfur-reducing bacteria and other miroorganisms can catalyze similar reactions with nitrogen compounds. Many groundwater bacteria use labile (e.g., humic and fulvic acids, kerogen) organic compounds as energy sources. Experiments with a labile compound, glutamic acid, demonstrated an uptake rate of 87 ng/l/h using groundwater bacteria from the Marmot Basin in southwestern Alberta. Although uptake and mineralization rates of refractory organic matter are slower, further experiments showed that groundwater bacteria could be grown on natural organic compounds extracted from coal mine overburden from the Forestburg Mine in central Alberta. The mineralization of organic matter in groundwater consumes oxygen and increases the partial pressure of carbon dioxide. CO2 production rates were found to range from 11 to 22 nM CO2/g/h in measurements made from coal mine overburden from central Alberta. Microorganisms can change the whole character of groundwater chemistry by altering oxygen concentration, pE and pH. As groundwater flows through porous media containing biodegradable organic material or minerals, microorganisms cause oxygen to be consumed and decreases in pE and pH. Carbonate minerals are attacked and the solubility of many other minerals is increased. If anoxic conditions result, hydrogen sulfide and methane may be produced. (See also W87-00892) (Lantz-PTT)
W87-00911

YEAR 4, RUNOFF WATER QUALITY, AUGUST 1980-AUGUST 1981,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-00935

EFFECTS OF SEATTLE AREA HIGHWAY STORMWATER RUNOFF ON AQUATIC BIOTA,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-00937

HIGHWAY RUNOFF IN WASHINGTON STATE: MODEL VALIDATION AND STATISTICAL ANALYSIS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-00938

GUIDE FOR WATER QUALITY IMPACT ASSESSMENT OF HIGHWAY OPERATIONS AND MAINTENANCE,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-00939

JOINT REPORT OF THE SPECIAL ENVOYS ON ACID RAIN,
D. Lewis, and W. Davis.
January 1986. 51 p.

Descriptors: *Water pollution effects, *Fate of pollutants, *Acid rain, *Canada, Precipitation, Sulfur dioxide, Nitrogen oxides, Sulfuric acid, Nitric acid, International agreement.

A joint report on transboundary acid rain was prepared by special envoys from the U.S. and Canada. It stressed that acid rain is both a serious environmental problem and a serious transboundary problem. Three key recommendations were issued: (1) initiation of a five-year, $5 billion program for commercial demonstration of clean coal technologies, (2) a commitment to ongoing cooperative activities, including bilateral consultations and information exchange, and (3) a greater emphasis on carrying out research essential to resolving transboundary acid rain issues. (Cassar-PTT)
W87-00940

PLAN TO EVALUATE ACID-DEPOSITION ISSUES IN THE STATE OF TEXAS, VOLUME I,
Espey, Huston and Associates, Inc., Austin, TX.
J. A. Levy.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE83-900918, Price codes: A04 in paper copy, A01 in microfiche. Report No. TENRAC/EDF -- 057-Vol. 1, January 15, 1982. Final report. 79 p, 2 fig, 4 tab, Project 80-L-11-6.

Descriptors: *Water pollution effects, *Acid rain, *Texas, *Water pollution sources, Fate of pollutants, Precipitation, Water pollution sources, Sulfur dioxide, Sulfuric acid, Nitrogen oxides, Nitric acid, Soil types.

A preliminary investigation of the effects of acid deposition in Texas indicates that this is not a problem of immediate concern for most of the state where alkaline soils prevail. However, parts of east Texas (particularly the timberlands) are sensitive to acid deposition and may experience problems in the future. Data from the well-monitored northeastern U.S. cannot be extrapolated to Texas. No significant anthropogenic emission sources exist; natural sources include sea salt, biogenic sulfur emissions from soils and vegetation, and alkaline particles from wind erosion. The meteorology is different, and the physical environment is generally less sensitive to acid pollution effects. In Texas, nitrogen oxide emissions far exceed sulfur dioxide emissions. (Cassar-PTT)
W87-00941

IMPACT ASSESSMENT REPORT: C.P. CRANE STEAM ELECTRIC STATION AQUATIC MONITORING PROGRAM,
Martin Marietta Corp., Baltimore, MD. Environmental Center.
F. Jacobs.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-179853,

Price codes: A05 in paper copy, A01 in microfiche. Volume 1, Report PPSP-CPC-82-1, January 1983. 89 p, 2 fig, 10 tab, 75 ref.

Descriptors: *Environmental effects, *Water pollution effects, *Fish, *Thermal pollution, *Powerplants, C. P. Crane Steam Electric Station, Baltimore Gas and Electric Company, Saltpeter Creek, Dundee Creek, Chesapeake Bay, Estuaries, Salinity, Waste heat, Thermal water, Temperature effects, Entrainment, Aquatic habitats.

Physical and chemical studies of the discharge creeks for the C. P. Crane Steam Electric Station were conducted during 1979-1980. A considerable area within Saltpeter Creek and Dundee Creek received plant discharge water with excess temperatures of 2 degrees C or greater. Salinity was also slightly increased in the discharge creeks. Biological effects on phytoplankton, zooplankton, benthos, and finfish were mainly limited to Saltpeter Creek, which was not found to be an important spawning area for anadromous species. Entrainment losses in the plant accounted for not more than 5% in adult populations of any species within the Gunpowder/Middle River estuaries or not more than 0.1% in the upper Chesapeake Bay. (Cassar-PTT)
W87-00943

PROCEEDINGS OF THE WORKSHOP ON AGRICHEMICALS AND ESTUARINE PRODUCTIVITY.
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Marine Pollution Assessment.
For primary bibliographic entry see Field 2L.
W87-00957

USES AND MISUSES OF ESTUARIES,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 2L.
W87-00959

SCIENTIFIC LESSONS TAUGHT BY KEPONE,
Virginia Inst. of Marine Science, Gloucester Point.
R. J. Hugget, and H. E. Bender.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 53-61, 2 fig, 8 ref.

Descriptors: *Fate of pollutants, *Estuaries, *Water pollution effects, *Kepone, Insecticides, Pesticides, James River, Bioaccumulation, Aquatic animals, Sediments, Bottom sediments, Rivers, Fish, Toxicity, Shellfish, Chlorinated hydrocarbons.

Kepone, a persistent polychlorinated hydrocarbon insecticide, entered the James River from a plant at Hopewell, Virginia. It has been studied as a tracer and surrogate of similar compounds in the aqueous environment. Thousands of analyses were conducted on fish, crabs, oysters, clams, water, and sediments since the chemical was discovered in the river in 1975. Some of the general findings are as follows: (1) Water solubility of Kepone is not helpful in predicting its concentration in solution in the environment. (2) The bottom sediments are the major reservoir for the chemical. (3) Kepone concentrations in bottom sediments depend on the consistency of the bottom sediments and the water currents. (4) Suspended sediment Kepone concentrations depend partly on current velocities. (5) Chronic damage from the aqueous exposure route to the river's aquatic life is unlikely. (6) Sublethal effects may occur in marine animals at relatively high (>1 microgram per gram) levels of food contamination. (7) Marine fishes accumulate Kepone in the natural environment to a considerably greater degree than is predicted from laboratory studies. (See also W87-00957) (Cassar-PTT)
W87-00960

MIREX, FIRE ANTS, AND ESTUARIES,
Environmental Research Lab., Gulf Breeze, FL.
J. I. Lowe.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 63-70, 14 ref.

Descriptors: *Water pollution effects, *Estuaries, *Mirex, Pesticides, Chlorinated hydrocarbons, Insecticides, Fire ants, Ants, Amdro, Aquatic life.

The insecticide mirex was used during 1962-1978 in the Southeastern U.S. for control of the fire ant. This chemical is highly toxic to a variety of marine crustaceans, including the commercially important shrimp and crabs. A 1969-1971 study revealed that mirex was found in tissues of estuarine biota, including shrimp, crabs, fish, marsh birds, and raccoons, in spite of efforts to avoid using the material in tidal zones. After several years of public hearings, mirex was banned in 1978. A new insecticide, Amdro (an amidinohydrazone compound) was approved for fire ant control in 1980. This substance is reported to provide good ant control and is relatively nontoxic to nontarget species. (See also W87-00957) (Cassar-PTT)
W87-00961

OVERVIEW OF ATRAZINE DYNAMICS IN ESTUARINE ECOSYSTEMS,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
J. C. Stevenson, T. W. Jones, W. M. Kemp, W. R. Boynton, and J. C. Means.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 71-94, 4 fig, 5 tab, 64 ref. EPA Grant R805932-01-2.

Descriptors: *Water pollution effects, *Estuaries, *Atrazine, Pesticides, Herbicides, Toxicity, Aquatic plants, Fate of pollutants, Algae, Submerged plants, Chesapeake Bay, Spartina alterniflora.

Atrazine, a s-triazine-type herbicide, exerts no significant effects on animals at concentrations < 1 ppm. However, estuarine plant life is adversely affected. Algae have a wide range of susceptibility to atrazine. Some species are sensitive to concentrations < 100 ppb; others like Chlorella can withstand concentrations > 1 ppm. The presence of atrazine can selectively affect some species over others and create algal blooms. Spartina alterniflora appears to have an atrazine detoxifying mechanism and can survive even at levels of 1 ppm. Estuarine submerged aquatics are relatively vulnerable to atrazine except for Eurasian milfoil. Although most of the levels reported in the Chesapeake Bay are < 1 ppb, there are indications that it can act synergistically with other herbicides such as linuron. An additional factor are the larger levels (25 ppb) likely during spring runoff storms during herbicide application periods. (See also W87-00957) (Cassar-PTT)
W87-00962

SIGNIFICANCE OF NON-POINT SOURCES OF NUTRIENTS TO EUTROPHICATION IN THE CHOWAN RIVER,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
A. M. Duda, and A. Klimek.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 95-116, 4 fig, 3 tab, 27 ref.

Descriptors: *Water pollution effects, *Estuaries, *Nonpoint pollution sources, Eutrophication, Chowan River, North Carolina, Nutrients, Agricultural watersheds, Algae, Rivers, Nitrogen, Phosphorus, Water quality, Nitrogen, Cyanophyta.

A very serious eutrophication problem currently exists in the Chowan River in eastern North Carolina. The nature and significance of the water quality problem as well as the relative contribution of the different sources of nutrients is examined. Nonpoint source loadings dominate the estimated annual flux of nutrients, with 85% of the nitrogen and 83% of the phosphorus load estimated to come from nonpoint sources. The results of intensive water quality sampling in agricultural watersheds are presented. Five-fold increases in average concentrations of inorganic nitrogen and total phosphorus occur in these agricultural watersheds over concentrations in a totally forested watershed. The importance of the spring contribution of these agricultural nutrients to the eutrophication problem is discussed. Common to the two years with massive blooms of blue-green algae were very high spring flows, low summer precipitation, and a slug of flow during the summer that may have delivered recycled nutrients from tributaries to the lower river. These agricultural nutrient inputs are also implicated as a significant source of the eutrophication problem in the Neuse and Pamlico River estuaries. In order to restore acceptable water quality, it is apparent that nutrient abatement action must include livestock operations, cropland in the well drained coastal plain, and cropland in watersheds that have extensive agricultural drainage improvements. (See also W87-00957) (Author's abstract)
W87-00963

EVALUATION OF PESTICIDE IMPACT ON THE ENVIRONMENT--SHORTCUT METHODS USEFUL FOR HAZARD ASSESSMENT,
Dow Chemical U.S.A., Midland, MI.
E. E. Kenaga.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 177-212, 21 tab, 30 ref.

Descriptors: *Water pollution effects, *Pesticides, *Toxicity, Fate of pollutants, Environmental effects, Aquatic plants, Aquatic animals, Chemical wastes, Runoff, Agricultural chemicals, Bioaccumulation, Partition coefficient.

The hazard evaluation of many chemicals required by the Environmental Protection Agency makes it necessary to use shortcut and surrogate toxicological and environmental fate test methods for obtaining data. The important techniques discussed are: (a) measurement and calculation of concentrations of residues from direct or indirect application of chemicals to various segments of the environment; (b) estimation of the distribution and partitioning of residues of chemicals between various media in the environment; (c) correlation of acute toxicity of chemicals to animals for selection of representative species for use in preliminary hazard assessment; (d) correlation of the toxicity of chemicals to aquatic plants with their toxicity to aquatic animals; (e) correlation of the toxicity of chemicals to various species of plants and seeds; and, (f) estimating chronic toxicity. (See also W87-00957) (Author's abstract)
W87-00966

ENVIRONMENTAL SAFETY EVALUATION OF DETERGENT CHEMICALS IN ESTUARINE ECOSYSTEMS,
A. W. Maki.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina September 18-19, 1980. December 1982. p 221-242, 3 fig, 6 tab, 19 ref.

Descriptors: *Water pollution effects, *Estuaries, *Toxicity, *Detergents, Wastewater pollution, Model studies, Computer models, Surfactants, Aquatic life, Shellfish, Oysters, Crabs, Shrimp, Fish, Lobsters, Hudson River, New York.

A study was conducted to relate laboratory-derived toxicity data for several commercially important marine species to model-calculated estimates of residual detergent chemical concentrations from 20 representative North American estuaries. Existing computer modeling techniques were applied to a generalized analysis of estuarine wastewater effluent, surfactant, and NTA chelating agent distributions. The model results were validated by com-

paring model-calculated concentrations to those determined from limited field monitoring programs. No-effect concentrations were determined for an anionic surfactant (linear alkyl benzene sulfonate), a nonionic surfactant (C14.5 alkyl ethoxylate), a cationic surfactant (dialkyl dimethyl ammonium chloride), and a builder (trisodium nitrilotriacetate). Aquatic animals used were sensitive life stages of oyster, shrimp, crab, mummichog, sheepshead minnow, clam, and lobster. Safety factors were then calculated for the test species by comparing the estimates of estuarine concentrations of surfactants with the laboratory toxicity data. Safety factors ranged from 3 in grossly impacted areas such as the lower Hudson River and New York Bight to greater than 100,000 in the east, Gulf, and west coast estuaries. (See also W87-00957) (Cassar-PTT)
W87-00968

ASSESSMENT OF GROUND AND SURFACE WATER EFFECTS AROUND COAL AND MINERAL STORAGE AREAS,
Hittman Associates, Inc., Columbia, MD.
D. H. Koch, J. R. Stetson, and B. R. Genes.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-168575, Price codes: A14 in paper copy, A01 in microfiche. Report No. BuMines OFR 12-83, July 1982. 306 p, 89 fig, 35 tab, 77 ref, 4 append. Contract J0199076.

Descriptors: *Groundwater quality, *Water quality, *Coal, *Minerals, *Mine drainage, Water quality assessment, Phosphate, Lead, Copper, Iron, Uranium, Water pollution control, Path of pollutants, Leaching, Water pollution effects.

The impacts of coal and mineral storage piles on both ground and surface water quality were investigated. Ten coal and mineral stockpile sites (5 coal and 5 mineral -- phosphate, lead, copper, iron, and uranium) across the country were visited to determine the actual impact of coal and mineral stockpiles on water quality. A series of leaching experiments was conducted in which drainage from the 10 coals and minerals was controlled and monitored to survey the extent to which storage piles release toxic ions to ground and surface waters. Pollution abatement techniques were reviewed in three generic treatment examples applied to lead-zinc ore, eastern coal, and uranium ore stockpile leachate. The study resulted in the following major conclusions: (1) Water quality impacts are site specific, (2) there is a high correlation between the sulfide content of a material and its solution potential, and (3) the selection of the best treatment alternative for a specific coal or mineral storage area must be based on site-specific criteria, pilot studies on representative leachate samples, and sound engineering design. (Author's abstract)
W87-00970

ACID DEPOSITION: LONG-TERM TRENDS.
National Research Council, Washington, DC. Committee on Monitoring and Assessment of Trends in Acid Deposition.
National Academy Press, Washington, DC. 1986. 506 p.

Descriptors: *Acid rain, *Environmental effects, *Data interpretation, *Monitoring, Reviews, Air pollution effects, National Research Council.

Recognizing that deposition of chemical pollutants from the atmosphere constitutes one of the more significant environmental issues of our time, both nationally and internationally, the National Research Council has undertaken a series of studies designed to summarize what is known about this complex phenomenon and to correct many of the misunderstandings surrounding it. A central objective of this activity has been to delineate more clearly the role of our industrial society in contributing to the chemical composition of the atmosphere as well as the consequences for the environment of the ultimate return of the pollutants to the Earth's surface. The current report addresses just one dimension of the relationships between emissions, deposition, and environmental effects. If industrial activity is implicated in atmospheric deposition, then the phenomenon is a relatively recent one and should be related to changes in the levels and kinds of such activity. It is logical, then, to seek historical data or other reliable information that may be available to assess whether emissions, deposition, and effects are temporally linked over the period since the beginning of industrialization. The Committee on Monitoring and Assessment of Trends in Acid Deposition was organized by the National Research Council to carry out the study. In the process of reviewing the literature and available data, the committee found that a number of the potentially informative sets of data that exist had previously not been analyzed for this purpose. It was concluded that in order to conduct a comprehensive study, it would be necessary for us to obtain and analyze these data. The report therefore contains not only a review of the literature but also original analyses of a number of data sets. The analyses, which commanded considerable commitments of time and energy from the members, permitted an assessment of the implications of findings for a number of diverse phenomena together, which greatly enhances the strength of the committee's conclusions. (See also W87-00972 through W87-00979) (Lantz-PTT)
W87-00971

SUMMARY AND SYNTHESIS.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 1-47, 5 fig, 5 tab, 20 ref.

Descriptors: *Acid rain, *Environmental effects, *Air pollution effects, Chemistry of precipitation, Spatial distribution, Temporal distribution, Sulfates, Nitrogen, Sulfur, Toxicity, Fish.

The issues raised by the possible adverse effects of acid deposition can be evaluated using scientific hypotheses which have been formulated linking postulated or observed effects to acid deposition and/or its precursors. This study was organized to investigate spatial patterns and temporal trends in acid deposition and its gaseous precursors in eastern North America and patterns and trends in environmental parameterrs that might result from acid deposition. It was assumed that if a mechanism existed linking acid deposition to an environmental effect, it should be possible to demonstrate that acid deposition is associated spatially and/or temporally with the effect. If such an association cannot be established, then either a cause-and-effect relationship does not exist or our of understanding the mechanisms and rate-governing factors is not adequate. Despite imperfect knowledge of the relationships between emissions and deposition and rates of responses of ecosystems, careful evaluation of data on phenomena that are linked to acid deposition by plausible mechanisms should provide additional insight into the relationships among emissions, deposition, and effects. Simultaneous examination of multiple patterns of spatial distributions and temporal trends provides a more robust test for the existence of linkages between emissions, deposition, and environmental effects than inferences based on data for pairs of phenomena. In conducting the study, it quickly became apparent that answers to questions about acid deposition have proved elusive because historical data from which to judge trends and hypothesize environmental responses are scare. To narrow down the field of study, the following were selected for inclusion: (1) Emissions of sulfur and nitrogen oxides, (2) Precipitation chemistry, (3) Atmospheric sulfates and visibility, (4) Surface water chemistry, (5) Sediment chemistry and abundance of diatom taxa, (6) Fish populations, and (7) Tree rings. (See also W87-00971) (Lantz-PTT)
W87-00972

PRECIPITATION CHEMISTRY,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W87-00974

FISH POPULATION TRENDS IN RESPONSE TO SURFACE WATER ACIDIFICATION,
Maine Univ. at Orono.
T. A. Haines.
IN: Acid Deposition: Long-Term Trends, National Academy Press, Washington, DC. 1986. p 300-334, 5 fig, 9 tab, 65 ref.

Descriptors: *Fish populations, *Acid rain, *Acidity, *Surface waters, Hydrogen ion concentration, Toxicity, Fishkill, Acid rain, Chemical analysis, Adirondack Mountains, New York, Nova Scotia, Pennsylvania, Massachusetts, Vermont, Maine.

The most widely reported consequence of acid deposition is the reduction or elimination of fish populations in response to surface water acidification. To demonstrate conclusively that fish population trends in a body of water are related to atmospheric acid deposition, temporal associations between surface water chemistry and fish populations are required: (1) to show that the water body formerly supported a viable fish population, either self-sustaining or hatchery-maintained, (2) that one or more fish species formerly present have been reduced or eliminated, (3) that the water body is more acidic now than when fish were present and that the increased acid level was not caused by local factors, and, (4) that other adverse factors are either absent or unimportant. The number of available data sets meeting these criteria is very small, and most have not been published in the peer-reviewed literature. This chapter reviews available North America data sets that purport to relate fish population status or trends to acid deposition. The strongest evidence in support of the hypothesis consists of temporal association data from Adirondack Mountain lakes and Nova Scotia rivers. Both data sets clearly demonstrate declines in acid-sensitive fish species populations over the past 20 to 40 years. Limited water chemistry data indicate that the lakes and streams in question are currently more acidic than they were previously, and fish population status is clearly correlated with present pH. Waters that are now acidic (pH < 5.0) support few or no fish populations. A temporal association study in Massachusetts streams provides similar results, although the number of streams is small and the data are of lesser quality. Data from Pennsylvania streams, Vermont lakes, and Maine lakes demonstrate that fish population status is related to present water chemistry. Generally, waters with summer pH less than 5.0 to 5.5 support few or no fish populations. Limited data suggest that at least some of these waters formerly supported fish. Limited field experimental data demonstrate that fish will not now survive in these acidic waters and that addition of acid to surface waters will eliminate fish populations. Although these data demonstrate a relationship between surface water acidity and fish population status, they cannot be used to determine the source of the acidity. (See also W87-00971) (Lantz-PTT)
W87-00976

EFFECTS OF CHRYSOTILE ASBESTOS ON COHO SALMON AND GREEN SUNFISH: EVIDENCE OF BEHAVIORAL AND PATHOLOGICAL STRESS,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
S. E. Belanger, K. Schurr, D. J. Allen, and A. F. Gohara.
Environmental Research ENVRAL, Vol. 39, No. 1, p 74-85, February 1986. 5 fig, 3 tab, 20 ref.

Descriptors: *Water pollutin effects, *Great Lakes, *Asbestos, *Salmon, *Sunfish, *Fish behavior, *Fish pathology, Stress, Larvae, Tissue analysis, Histology, Mortality.

The effects of chrysolite asbestos on recently hatched coho salmon larvae and juvenile green sunfish were investigated. Exposure levels were in the range similar to those known in several aquatic environments and consistent with those reported for the Great Lakes basin. Behavioral stress indicators such as loss of rheotaxic position and balance were observed. Exposed coho larvae were more susceptible to an anesthetic stress test than control specimens. Cytological examination of ventral skin tissue showed histolysis and transmission electron microscopy confirmed the presence of asbestos. Distortion of the lateral line region in treated salmon was linked to behavioral and orientational aberrations. Differences in mortality was not ob-

served between control and treated groups in either species. (Michael-PTT)
W87-01013

EFFECT OF PESTICIDE ON CIRCULATING THYROID HORMONE LEVELS IN THE FRESHWATER CATFISH, HETEROPNEUSTES FOSSILIS (BLOCH),
Banaras Hindu Univ., Varanasi (India). Fish Endocrinology Lab.
A. K. Yadav, and T. P. Singh.
Environmental Research ENVRAL, Vol. 39, No. 1, p 136-142, February 1986. 2 fig, 2 tab, 22 ref. CSIR (7/13(1373)80-81/EMR-I), ICAR (PL 480 Project No. IN-ARS-213, Grant No. FG-IN-620).

Descriptors: *Water pollution effects, *Chlorinated pesticides, *Malathion, *BHC, *Catfish, *Thyroid, *Hormones, Pesticides, Plasma, Thyroxine, Triiodothyronine, India, Fish physiology, Fish toxins, Enzymes.

The effects of two pesticides on thyroid hormone levels in freshwater catfish is examined. The circulating plasma levels of thyroxine (T4) and triiodothyronine (T3) were analyzed during the prespawning phase of reproduction. A lower T4 level was noticed within four weeks of exposure to cythion (50% malathion) and hexachlorocyclohexane (BHC). Higher concentrations of BHC increased the plasma T4 level. BHC-exposed fish showed lower plasma T3 and T3 to T4 ratios while malathion exposure raised these levels. Since BHC was seen to act directly on the thyroid gland, synthesis and release of thyroid hormone was reduced. Malathion seemed to increase plasma T3 levels by either stimulating extra-thyroidal conversion of T4 to T3 or reducing T3 excretion, thereby increasing plasma T3 and the T3 to T4 ratio in this species. (Michael-PTT)
W87-01014

LONG-TERM DECLINES IN RADIOCESIUM OF TWO SYMPATRIC SNAKE POPULATIONS,
Savannah River Ecology Lab., Aiken, SC.
C. Bagshaw, and I. L. Brisbin, Jr.
Journal of Applied Ecology JAPEAI, Vol. 21, No. 2, p 407-413, August 1984. 1 fig, 2 tab, 24 ref. DOE Contract DE-AC09-76SR00819.

Descriptors: *Path of pollutants, *Cesium radionuclides, *Snakes, *Body burden, *Effluent streams, *Savannah River, *Nuclear powerplants, Aquatic animals, Radioactive half-life, Model studies.

The patterns and rates of radiocesium decline in two populations of snakes inhabiting the effluent stream of the Savannah River nuclear powerplant were studied between 1972 and 1980. No differences were found in the rates at which average body burdens of radiocesium decreased over time. A linear model using natural-log transformed data adequately described this decrease in one population, but was not adequate for the other. Radiocesium concentrations in species sampled in uncontaminated areas were up to two orders of magnitude lower than those in snakes from the contaminated habitat. The persistence of radiocesium in snakes from uncontaminated areas is discussed in terms of ecological half-lives. (Michael-PTT)
W87-01016

METABOLIC ENZYME INDUCTION IN THE RAT BY ORGANIC RIVER SEDIMENT POLLUTANTS,
Science Univ. of Tokyo. (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5B.
W87-01028

HEAVY METALS AND SELENIUM VARIATION IN A MIGRATORY BIRD WINTERING IN A MERCURY-POLLUTED LAGOON,
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
C. Leonzio, C. Fossi, and S. Focardi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 219-225, August 1986. 3 fig, 2 tab, 17 ref. ECC (ENV 512/I).

Descriptors: *Path of pollutants, *Mercury, *Water pollution effects, *Selenium, *Heavy metals, *Bioaccumulation, *Black-necked Grebe, *Lagoons, *Wintering, *Seasonal depletion, Monitoring, Marano Lagoon, Italy, Lead, Cadmium, Liver, Kidney, Brain, Fat, Muscle, Uropygial gland.

Results are reported of the long-term monitoring of Hg, Cd, Pb, and Se and their interactions in the tissues of the Black-necked Grebe (Podiceps nigricollis) wintering in the lagoon of Marano (northeast Italy), an environment moderately polluted by industry. Concentrations of Hg (microgram/gram dry weight (ug/g)) were highest in liver (9.37-57.90 ug/g) and lowest in fat (0.53-1.14 ug/g). Values were intermediate in uropygial gland, brain, muscle, and kidney. During wintering in the lagoon, Hg increased in all six tissues. Se concentrations in the liver, kidney, and brain were generally higher than 10 ug/g, whereas in the other tissues they were typically below 5 ug/g; the seasonal changes were not as clear. For Cd, concentrations were below detection limits (0.02 ug/g) except in the liver and kidney; averages tended to be higher in autumn. The levels of Pb were low in all organs (often undetectable), with no seasonal variations. (Rochester-PTT)
W87-01029

HEAVY METAL BIOACCUMULATION AND EFFECTS ON WATERHYACINTH WEEVILS, NEOCHETINA EICHHORNIAE, FEEDING ON WATERHYACINTH, EICHHORNIA CRASSIPES,
Delta State Univ., Cleveland, MS. Center for Alluvial Plains Studies.
S. H. Kay, and W. T. Haller.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 239-245, August 1986. 1 fig, 1 tab, 15 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Heavy metals, *Bioaccumulation, *Toxicity, *Water hyacinth weevils, Water hyacinth, Lead, Cadmium, Copper, Mortality, Feeding.

The influence of Pb, Cd, and Cu absorbed by water hyacinth on the feeding, body burdens, and mortality of waterhyacinth weevil, Neochetina eichhorniae, were studied with plants growing in 70-l containers. Adult weevils collected in the field were used in feeding experiments. The metals in water hyacinths had no effect on feeding or mortality of the weevils. At the levels and lengths of exposure Pb (1.0 and 5.0 mg/l, 10 and 20 days), Cd (0.5 and 1.0 mg/l, 10 and 20 days), and Cu (1.0 and 2.5 mg/l, 10 and 20 days) were not accumulated sufficiently by the insects to cause either acute or chronic toxicity. This outcome suggests that environmental Pb, Cd, and Cu are not likely to adversely affect adult weevils; effects on larvae and pupae were not addressed here. (Rochester-PTT)
W87-01030

MORTALITY OF SMOLT OF ATLANTIC SALMON, SALMO SALAR L., AT LOW LEVELS OF ALUMINIUM IN ACIDIC SOFTWATER,
Direktoratet for Vilt og Ferskvannsfisk, Aas (Norway). Fish Research Div.
O. K. Skogheim, and B. O. Rosseland.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 258-265, August 1986. 2 fig, 2 tab, 12 ref.

Descriptors: *Water pollution effects, *Aluminum, *Atlantic salmon, *Smolts, *Acidic water, Lake Liervatn, Norway, Hydrogen ion concentration, Reproduction, Survival, Populations, Sublethal stress.

To establish toxic levels of labile Al in the water of Lake Liervatn, southwest Norway, sublethally stressed salmon smolts from the lake were exposed to lake water (pH 5.07, Ca 1.3 mg/l, and labile Al 38 microgram (ug) Al/l) enriched with inorganic Al to three concentrations of labile Al: 75, 137, and 177 ug Al/l. At pH 5.06 and 75 ug Al/l of labile Al, 50% mortality (LT50) was reached at 108 hr; with pH 4.92 and 137 ug Al/l of labile Al, the LT50 was 38 hr; and at pH 4.9 and 177 ug Al/l of labile Al the LT50 was 32 hr. Episodic changes in pH and Al concentration in the ranges used in this study have been associated with fish kills in a Norwegian river, indicating that sensitivity of Atlantic salmon to Al during smoltification may be critical to survival of salmon populations. (Rochester-PTT)
W87-01032

SUBMICROSCOPIC HEPATIC AND RENAL PATHOLOGY OF A TELEOST MAINTAINED IN SEWAGE,
Gorakhpur Univ. (India). Dept. of Zoology.
A. S. Narain, and P. Nath.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 266-273, August 1986. 21 fig, 7 ref.

Descriptors: *Sewage, *Teleosts, *Toxicity, *Water pollution effects, *Transmission electron microscopy, Kidney, Liver, Mitochondria, Cells, Fish, Rough endoplasmic reticulum, Nucleus, Nucleolus, Fibrosis, Necrosis.

Damage associated with exposure of the teleost fish Heteropneustes fossilis to sewage was assessed using transmission electron microscopy. Fish were collected in unpolluted habitats and maintained in aquaria filled with 25% sewage collected from open sewers and 75% tap water. Marked subcellular damage was evident in liver and kidney cells, including increased vacuolization, decreased numbers of mitochondria, disorganization of the rough endoplasmic reticulum, increased macrophage activity of the sinusoids, and decrease in nuclear size and nucleolar degeneration. The submicroscopic and renal pathology generally reflects a widespread degenerative and necrotic inflammatory condition; the presence of fibrosis in many cells suggests a chronic condition. (Rochester-PTT)
W87-01033

TOXIC EFFECTS OF ACRYLAMIDE IN A FRESHWATER FISH, HETEROPNEUSTES FOSSILIS,
Industrial Toxicology Research Centre, Lucknow (India).
R. Shankar, and P. K. Seth.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 274-280, August 1986. 4 tab, 20 ref.

Descriptors: *Teleosts, *Water pollution effects, *Acrylamide, *Hepatic glutathione, *Glutathione-S-transferase, *Toxicity, Enzymes, Stress, Paralysis, Nervous system, Fish, Mortality, Bioassay.

Median lethal concentration (LC50) of acrylamide in Heteropneustes fossilis and the compound's effect on hepatic glutathione and glutathione-S-transferase (GST) levels were determined. The 24- and 48-hr LC50 values for acrylamide were 104.13 and 86.81 mg/l. After 10 hr exposure to the 24-hr LC50 concentration, fish showed signs of excitation, irritability, gulping of air at the surface and erratic swimming. Prior to death the tail and fins appeared to be paralyzed, the dorsal fin had collapsed, and there appeared to be some loss of sensitivity to sound and body orientation. The no-effect level of acrylamide was 15 mg/l for 48 hr. Exposure to 34.7 mg/l acrylamide for 24 hr resulted in a significant fall in hepatic glutathione and GST levels, but exposure to 20.8 mg/l for the same period did not lead to any significant change. A dose-dependent decrease in glutathione and GST activity was noted in the fishes after intraperitoneal administration of acrylamide. (Rochester-PTT)
W87-01034

ACUTE TOXICITY OF METHYL MERCURY TO THE LARVAL LAMPREY, PETROMYZON MARINUS,
Washington State Univ., Pullman. Dept. of Zoology.
J. Mallatt, M. G. Barron, and C. McDonough.
Bulletin of Environmental Contamination and

Toxicology BECTA6, Vol. 37, No. 2, p 281-288, August 1986. 1 fig, 4 tab, 15 ref.

Descriptors: *Water pollution effects, *Toxicity, *Lamprey, *Methylmercury, Larvae, Mortality, Statistics, Larvae, Hardness.

Acute toxicity curves were obtained for the larvae (ammocoetes) of Petromyzon marinus exposed to methyl mercuric chloride solutions. Lethal concentration for 50% of the ammocoetes (LC50) at 12 C, with hardness of 146 mg CaCO3/l and 0.3-3 gram fish, was >166 microgram (ug) Hg/l at 24 hr, 88 ug/l at 48 hr, and 48 at 96 hr. At 4 C, the LC50 occurred first at 72 hr (191 ug/l), and at 96 hr (88 ug/l), and 120 hr (57 ug/l), whereas at 20 C, the 24-hr LC50 was 90 ug/l and the 36-hr LC50 was 34 ug/l. No statistically significant relationship between animal size and toxicity was found, although one of four tests had suggested such a relationship. (Rochester-PTT)
W87-01035

ACUTE TOXICITY OF SAPONIFIED CASTOR OIL TO CHANNEL CATFISH, ICTALURUS PUNCTATUS, UNDER LABORATORY AND FIELD CONDITIONS,
Mississippi Agricultural and Forestry Experiment Station, Mississippi State.
C. S. Tucker, R. Francis-Floyd, and M. H. Beleau.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 297-302, August 1986. 1 fig, 1 tab, 7 ref. USDA Agreement 84-CSRS-2-2363.

Descriptors: *Water pollution effects, *Saponified castor oil, *Calcium, *Solricin-135, *Catfish farming, *Toxicity, Bioassay, Mortality, Catfish.

Acute toxicity of Solricin 135 to channel catfish fingerlings under four environmental concentrations was determined and a field test was conducted to compare the laboratory-derived data to the toxicity of Solricin 135 under conditions typical of commercial channel catfish production ponds. The 96-hr LC50 values in laboratory tests ranged from 25-59 mg/l saponified castor oil decreased as the Ca concentration in the test water increased. In all the laboratory tests most of the fish died within the first 24 hr of exposure, with none dying from 48-96 hr of exposure. Although results are not directly comparable, saponified castor oil appeared to be more toxic to fish in ponds than in the laboratory. The concentration of saponified castor oil in the pond where all the fish eventually died (24 mg/l) was much less than the 96-hr LC01 (about 40 mg/l) under laboratory conditions at similar environmental Ca concentrations (about 80 mg/l Ca). Sublethal hypoxia and catharsis in fish exposed to more than about 10 mg/l saponified castor oil may stress the animal and result in infection by opportunistic bacterial pathogens. (Rochester-PTT)
W87-01036

ACUTE TOXICITY OF CADMIUM AND SODIUM PENTACHLOROPHENATE TO DAPHNIDS AND FISH,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
W. S. Hall, R. L. Paulson, L. W. Hall, Jr., and D. T. Burton.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 2, p 308-316, August 1986. 5 tab, 14 ref.

Descriptors: *Crustaceans, *Toxicity, *Cadmium, *Sodium pentachlorophenate, *Daphnia, *Fish, *Mortality, Bioassay.

The sensitivity of Daphnia magna, Daphnia pulex, Ceriodaphnia reticulata, and Pimephales promelas to the reference toxicants CdCl2 and sodium pentachlorophenate (NaPCP) was compared and the effect of different dilution waters on the acute toxicity of the reference toxicants was evaluated. The four species were similarly sensitive to Cd under the conditions employed. The invertebrates were similar in their sensitivity to NaPCP or PCP, but data for P. promelas were too limited to draw a conclusion as to the relative sensitivity of this species. Estimates of LC50s within a range of an order of magnitude are obtainable for these chemical and test organisms using similar test conditions. Differences in dilution waters used in this study did not influence the results of acute toxicity tests with Cd or NaPCP. (Rochester-PTT)
W87-01037

CADMIUM TRANSPORT, RESISTANCE, AND TOXICITY IN BACTERIA, ALGAE, AND FUNGI,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors, G. W. Stratton, and G. M. Gadd.
Canadian Journal of Microbiology CJBOAW, Vol. 32, No. 6, p 447-464, June 1986. 1 fig, 5 tab, 185 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Toxicity, *Cadmium, *Transport, *Bacteria, *Algae, *Fungi, Plant physiology, Bacterial physiology, Cyanobacteria, Plasmid-encoded resistance, Genetics, Growth, Photosynthesis, Nitrogen fixation, Morphology, Cell wall binding, Polysaccharides, Proteins, Metabolism, Cations, Kinetics.

Cadmium exerts its toxic effect(s) over a wide range of concentrations. In most cases, algae and cyanobacteria are the most sensitive organisms, whereas bacteria and fungi appear to be more resistant. In some bacteria, plasmid-encoded resistance can lead to reduced Cd(2+) uptake, but some Gram-negative bacteria without plasmids are just as resistant to Cd as are bacteria containing plasmids encoding for Cd resistance. Genetic mechanisms of Cd uptake and resistance in cyanobacteria and algae remain largely unknown at present. Cd is toxic to these organisms, causing severe inhibition of such physiological processes as growth, photosynthesis, and N-fixation at concentrations less than 2 ppm and often in the ppb range. Cd also causes pronounced morphological aberrations in these organisms, probably as a result of effects on cell division. Cd is accumulated by algae as the result of a two-phase uptake process, which involves rapid adsorption to cell wall binding sites (probably proteins and/or polysaccharides) followed by a lag period and then slow, steady intracellular uptake by an energy-dependent process, possibly involving the transport mechanisms used to accumulate other divalent cations. There is little information available about Cd uptake in filamentous fungi, and even in yeasts, information on specificity, kinetics and mechanisms of Cd uptake is limited. (Rochester-PTT)
W87-01038

GLYCOLATE METABOLISM BY PSEUDOMONAS SP., STRAIN S22, ISOLATED FROM A COASTAL MARINE SEDIMENT,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 2L.
W87-01050

IMPORTANCE OF PICOCYANOBACTERIA BIOMASS (UNICELLULAR, BLUE-GREEN ALGAE) IN THE PHYTOPLANKTON POPULATION OF THE COASTAL WATERS OF JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W87-01055

BLOOMS OF THE DINOFLAGELLATE GYRODINIUM AUREOLUM IN A LONG ISLAND ESTUARY: BOX MODEL ANALYSIS OF BLOOM MAINTENANCE,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. Chang, and E. J. Carpenter.
Marine Biology MBIOAJ, Vol. 89, No. 1, p 83-93, October 1985. 12 fig, 3 tab, 39 ref. New York Sea Grant Institute NA81AAD00027.

Descriptors: *Dinoflagellates, *Gyrodinium aureolum, *Eutrophication, *Red tide, *Long Island, *Estuaries, *Temperature, *Chlorophyll, *Box models, Mathematical models, Circulation, Vertical migration, Growth, Plant physiology, Cell division, Carmans estuary, New York, Flushing, Mixing, Grazing pressure.

A dense bloom of Gyrodinium aureolum Hulburt in Carmans estuary, Long Island, New York, was monitored during the summers of 1982 and 1983. The bloom typically was extremely localized, with its densest part exceeding 1,000 microgram chlorophyll a/liter (20,000 cells/ml). The bloom began at temperatures between 24.5 and 27 C, existed up to 30 C, and terminated when water temperature dropped to between 19 and 22 C. The highest specific growth rate measured was 0.90/day (1.3 divisions/day) and near the termination of the bloom this decreased to 0.28/day (0.4 divisions/day). A diel vertical migration of the bloom was observed. A box model analysis, based on division rates, vertical migration, and water circulation patterns, indicated that the bloom must move downward at the estuary mouth to maintain itself in the estuary, either by means of a convergence system or by downward swimming. High growth rate, low grazing pressure, and a stratified water column are proposed to stimulate bloom formation. Decreasing growth rate appeared to reduce the intensity of the bloom and finally allowed its disappearance by estuarine flushing and mixing. (Author's abstract)
W87-01056

EFFECT OF SELENITE AND SELENIFEROUS FLY-ASH LEACHATE ON GROWTH AND VIABILITY OF THE MARINE AMPHIPOD ALLORCHESTES COMPRESSA,
Australian Atomic Energy Commission Research Establishment, Sutherland.
M. Ahsanullah, and G. W. Brand.
Marine Biology MBIOAJ, Vol. 89, No. 3, p 245-248, November 1985. 4 tab, 12 ref.

Descriptors: *Water pollution effects, *Selenium, *Amphipods, *Selenium, *Fly-ash, *Leachates, *Growth, *Toxicity, Coal, Selenite, Seleniferous fly-ash, Application factors, Water quality standards, Marine environment.

Juveniles of Allorchestes compressa Dana were exposed to sodium selenite and seleniferous leachate from coal fly-ash. A maximum acceptable toxicant concentration for selenite of >44<93 microgram Se/liter is indicated by the results for growth and viability. Leachate:sea water mixtures produced effects that were consistent with selenite toxicity but quantitatively less drastic than expected from the result with pure selenite, perhaps because of sulfate antagonism. A comparison of the present results with selenium toxicity data for other aquatic species highlights the difficulties of using application factors as the basis for water quality criteria. (Author's abstract)
W87-01059

QUANTITATIVE DISTRIBUTION OF THE MEIOFAUNA IN THE VICINITY OF MARSEILLES' SEWAGE OUTFALL (DISTRIBUTION QUANTITATIVE DE LA MEIOFAUNE DANS L'AIR D'EPANDAGE DE L'EGOUT DE MARSEILLE),
Aix-Marseille-3 Univ. (France). Lab. de Biologie des Invertebres Marine.
M. Keller.
Marine Biology MBIOAJ, Vol. 89, No. 3, p 293-302, November 1985. 3 fig, 6 tab, 26 ref.

Descriptors: *Nematodes, *Copepods, *Annelids, *Acarians, *Macrobenthos, *Outfall sewers, Marseilles, France, Density, Larvae, Coastal waters.

The meiofauna along a transect off Marseilles (France) sewage outfall was counted and average and total biomass of nematodes and copepods were calculated for each station for November 1981. Three sections were identified: (1) a heavily-polluted coastal zone (30-150 m from the outfall), with a relatively poor meiofauna composed mainly of nematodes and copepods, but including numerous acarians and naupliar larvae (probably copepods); the copepods were uncommonly large and alone

constituted most of the total benthic biomass in this zone; (2) another polluted zone, 400-1,150 m from the coast, but with a more diversified meiofauna consisting of annelids (mainly polychaetes), with acarians becoming scarce and copepods decreased in size; at 400 m away from the outfall, where the sediment is strongly polluted, the nematode population consisted of large individuals, but by 400-800 m, both the meiofauna and macrobenthos were hetergeneous and at 1,150 m away, maximal meiofaunal densities were recorded; and (3) an offshore zone (1.8-4 km from the coast), which was slightly polluted, with reduced meiofauna densities and individuals decreased in size. (Rochester-PTT)
W87-01060

DISSOLVED ORGANIC SUBSTANCES DURING A PHAEOCYSTIS POUCHETII BLOOM IN THE GERMAN BIGHT (NORTH SEA),
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
K. Eberlein, M. T. Leal, K. D. Hammer, and W. Hickel.
Marine Biology MBIOAJ, Vol. 89, No. 3, p 311-316, November 1985. 2 fig, 1 tab, 18 ref. Consejo Nacional de Ciencia y Tecnologia (Mexico) Grant 25371.

Descriptors: *Carbohydrates, *Organic nitrogen, *Amino acids, *Sea foam, *North Sea, *Eutrophication, *Chrysophyta, Frisian coastal waters, Salinity, River water, Decomposition, Red tide, Dissolved organic matter.

Dissolved organic substances (carbohydrates, organic N, and free amino acids) were measured in the German Bight in June 1981. During and before this survey, sea foam was observed in the east Frisian coastal water and it accumulated on nearby beaches. In this coastal water area, a large Phaeocystis pouchetii Lagerheim bloom and very high concentrations of dissolved organic matter were found. Dissolved organic substances were correlated highly significantly with cell numbers of P pouchetii in the bloom area. Influences of salinity and river water on the correlation were excluded, suggesting that exudation or decomposition products of P pouchetii were most likely the cause of the unusually high concentrations of dissolved organic matter in the bloom area. Ammonia concentrations in the bloom area were very low, possibly indicating that decomposition of dissolved organic matter by bacteria could have been reduced by antibiotic activity of P pouchetii. (Rochester-PTT)
W87-01061

ADAPTIVE MICROSTRUCTURE OF THE SPINES OF PARACENTROTUS LIVIDUS (ECHINODERMATA: ECHINODEA) IN AN AREA POLLUTED BY DOMESTIC EFFLUENT (MICROSTRUCTURE ADAPTATIVE DES RADIOLES DE PARACENTROTUS LIVIDUS (ECHINODERMATA: ECHINOIDEA) EN MILIEU EUTROPHISE PAR DES EAUX USEES),
Aix-Marseille-3 Univ. (France). Faculte des Sciences et Techniques.
M. B. Regis.
Marine Biology MBIOAJ, Vol. 90, No. 2, p 271-277, January 1986. 4 fig, 1 tab, 16 ref.

Descriptors: *Adaptation, *Spines, *Sestonophagy, *Echinoderms, *Eutrophication, *Mediterranean Sea, Particulate organic matter, Dissolved organic matter, Scanning electron microscopy, Feeding, France, Outfall sewers, Morphology.

Investigations in 1984 on populations of Paracentrotus lividus (Lamarck) exposed to massive domestic pollution from the Cortiou sewage outlet (Marseille, France) revealed a significant lengthening of its spines at sites located 500 m (Station 0) and 1,200 m (Station 1) from the outlet. The spine lengthening appears to be a morpho-functional adaptation, enabling the sea-urchins to adopt sestonophagy in order to benefit better from the plentiful resources of both particulate and dissolved organic matter arising from the outfall; examination of pellets filling the stomachs and guts of the sea-urchins corroborated this. Scanning electron microscopic examination showed that spines of specimens collected at Station O were more 'porous' than those from Station 3 (5,200 m from outfall) and their microarchitecture was better adapted to capturing suspended particulate matter: the ridges were narrower, grooves wider, and the latter displayed a dense and more coarsely-meshed network. P lividus spines from Station 0 were lighter (ratio of dry weight of spine: dry weight of test) than those from Station 3. (Rochester-PTT)
W87-01066

CONTRIBUTION TO THE ECOTOXICOLOGICAL STUDY OF CADMIUM, LEAD, COPPER, AND ZINC IN THE MUSSEL MYTILUS EDULIS: I. FIELD STUDY,
Nantes Univ. (France). Centre de Dosage des Elements Traces.
For primary bibliographic entry see Field 5B.
W87-01067

NITRITE-INDUCED PREDISPOSITION OF CHANNEL CATFISH TO BACTERIAL DISEASES,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
L. A. Hanson, and J. M. Grizzle.
Progressive Fish Culturist PFCUAY, Vol. 47, No. 2, p 98-101, April 1985. 1 fig, 17 ref.

Descriptors: *Water pollution effects, *Nitrites, *Cat fish, *Bacterial diseases, *Toxicity, *Bacterial clearance rates, *Commercial fisheries, Fish toxins, Sublethal effects, Sublethal exposure, Fish diseases.

Channel catfish, Ictalurus punctatus, continuously exposed to 6 mg/L (ppm) nitrite and intraperitoneally injected with Aeromonas hydrophila had lower bacterial median lethal doses (LD50) than control fish. The clearance rate of injected A. hydrophila was reduced in fish chronically exposed to 5 mg/L (ppm) nitrite. Flexibacter columnaris infections occurred spontaneously in channel catfish exposed to 5 mg/L (ppm) nitrite for 7 days. None of the control fish became infected with F. columnaris. The first death of fish exposed to nitrite occurred on the second day after injection with A. hydrophila; mortalities were 28-43% during the first four days following injection. The increased susceptibility of channel catfish to bacterial diseases following sublethal nitrite exposure may be a more important chronic effect of nitrite exposure than methoglobin because the catfish can acclimate to the methemoglobin producing effects of nitrite. (Alexander-PTT)
W87-01076

USE OF METABOLIC INHIBITORS TO ESTIMATE PROTOZOOPLANKTON GRAZING AND BACTERIAL PRODUCTION IN A MONOMICTIC EUTROPHIC LAKE WITH AN ANAEROBIC HYPOLIMNION,
Georgia Univ., Athens. Dept. of Zoology.
R. W. Sanders, and K. G. Porter.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 1, p 101-107, July 1986. 2 fig, 3 tab, 54 ref. NSF Grant BSR-8407928.

Descriptors: *Cycloheximide, *Amphotericin B, *Penicillin, *Chloramphenicol, *Zooplankton, *Grazing, *Anaerobic conditions, *Hypolimnion, Bacterial physiology, Lake Oglethorpe, Georgia, Tritiated thymidine, Isotope studies, Swimming, Feeding, Latex beads, Metabolism, Differential filtration, Protozoa.

Inhibitors of eucaryotes (cycloheximide and amphotericin B) and procaryotes (penicillin and chloramphenicol) were used to estimate bacterivory and bacterial production in a eutrophic lake (Lake Oglethorpe, Georgia). Use of penicillin and cycloheximide yielded inconsistent results in anaerobic water and in aerobic water when bacterial production was low. Production measured by inhibiting eucaryotes with cycloheximide did not always agree with (3H)thymidine estimates or differential filtration methods. Laboratory experiments showed that several common freshwater protozoans continued to swim and ingest bacterium-size latex beads in the presence of the eucaryote inhibitor. Penicillin also affected grazing rates of some ciliates. Caution and a corroborating method are recommended when estimating ecologically important parameters using specific inhibitors. (Author's abstract)
W87-01078

BACTERIAL INHIBITORS IN LAKE WATER,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
T. M. Klein, and M. Alexander.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 1, p 114-118, July 1986. 3 fig, 5 tab, 19 ref. EPA R807688020, CR8122330210.

Descriptors: *Bacteria, *Toxins, *Toxicity, *Lake water, *Seasonal distribution, Dialysis, Cation-exchange resin, Anion-exchange resin, Cayuga Lake, Beebe Lake, Dryden Lake, White Lake, Black River, New York, Hydrogen ion concentration, Heat, Buffer, Seasonal depletion, Populations.

The populations of six bacterial genera fell rapidly after their addition to sterile lake water but not after their addition to buffer. The decline in numbers of two species that were studied further, Klebsiella pneumoniae and Micrococcus flavus, occurred even when the buffer was added to sterile lake water. The inhibition of K pneumoniae by substances in lake water varied with the season of the year, and the rate and extent of decline of both species were different in sterile samples of different lakes (Cayuga, Beebe, Dryden, and White Lakes and Black River, New York). The extent of reduction in the density of K pneumoniae was independent of initial population size and was diminished by the addition of 10 microgram of glucose per ml of lake water. The toxin was removed from lake water by dialysis and by a cation-exchange resin but not by an anion-exchange resin, and it was destroyed by heating. The inhibition of K pneumoniae was not evident in lake water buffered at a pH value above 8. Toxins may be important in determining composition of the bacterial community of lakes. (Author's abstract)
W87-01079

MICROOXIC-ANOXIC NICHE OF BEGGIATOA SPP.: MICROELECTRODE SURVEY OF MARINE AND FRESHWATER STRAINS,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
D. C. Nelson, N. P. Revsbech, and B. B. Jorgensen.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 1, p 161-168, July 1986. 7 fig, 2 tab, 32 ref. National Science Research Council (Denmark) Grant 11-4145 and NSF Grant PCM-8314358.

Descriptors: *Beggiatoa, *Microelectrodes, *Anaerobic conditions, *Oxygen, *Sulfides, Gradient media, Diffusion, Nitrogen fixation, Growth, Bacterial physiology, Seawater, Lithoautotrophs, Culture media.

Microelectrodes were employed to characterize oxygen and sulfide gradients during their initial development in uninoculated media and in cultures of marine and freshwater Beggiatoa spp strains. In gradient media, Beggiatoa strains always grew some distance below the air/agar interface as a dense 'plate' of constantly gliding filaments with sharply demarcated upper and lower boundaries. Within established plates, the maximum oxygen partial pressure was 0.6-6.0% of air saturation and not significantly lower if filaments were fixing nitrogen. Oxygen penetrated only 100-300 micron into the plate, and the anoxic fraction increased from less than 10% to approximately 90% during later stages of growth. For lithoautotrophically grown marine strains, the linearity of the oxygen profile above the plate plus its drop to zero therein indicated that oxygen uptake for the entire tube occurred only within the Beggiatoa plate. For freshwater strains grown heterotrophically (with sulfide in the medium), oxygen profiles frequently were nonlinear because of nonbiological reaction with sulfide. For all strains tested, microoxic ag-

gregation also occurred in the absence of sulfide, apparently reflecting a step-up phobic response to oxygen. (Author's abstract)
W87-01080

MINE WASTE POLLUTION OF THE MOLONGLO RIVER, NEW SOUTH WALES AND THE AUSTRALIAN CAPITAL TERRITORY: EFFECTIVENESS OF REMEDIAL WORKS AT CAPTAINS FLAT MINING AREA,
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
R. H. Norris.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 2, p 147-157, 1986. 1 fig, 5 tab, 19 ref.

Descriptors: *Molonglo River, *Metals, *Mine wastes, *Spoil banks, *Benthic invertebrates, Erosion, Mollusks, Crustaceans, Aquatic insects, Grasses, Remedies.

A biological study of the Molonglo River (Australia) published in 1967 was repeated to assess the effectiveness of remedial works installed at the Captains Flat mining area, where trace metal contamination had occurred since 1939. Remedial works, commenced in 1974, had involved reshaping of the tailings dumps and capping them with impervious material to prevent surface runoff and erosion. The caps to the reshaped dumps were stabilized with shallow vegetation (mainly grasses). The impact of metal contamination as it entered the river was shown by the lower variety and numbers of animals (Annelida, Gastropoda, Bivalvia, Crustacea, Insecta) collected at downstream compared to upstream areas. Comparison with the earlier study showed that there has been little or no discernible change to the chemical or biological condition of the river during periods of low flow. (Rochester-PTT)
W87-01083

RAPID BIOLOGICAL ASSAY AND LIMITATIONS IN MACROPHYTE ECOTOXICOLOGY: A REVIEW,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 5A.
W87-01088

ACID RAIN: THE EFFECTS OF PH, ALUMINUM, AND LEAF DECOMPOSITION PRODUCTS ON FISH SURVIVAL,
Louisiana State Univ., Baton Rouge.
J. W. Robinson, and P. M. Deano.
American Laboratory, Vol. 18, No. 7 p 17-26, July 1986. 13 fig, 2 tab, 10 ref.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Aluminum, *Fish, *Toxicity, *Decomposing organic matter, Survival, Buffering capacity, Golden Shiners, Pine, Cypress, Willow.

Effects of decaying leaves on pH, buffer capacity, fish (Golden Shiners, Notemigonus crystoleucas), effects of decomposed leaves on dissolved alumina, and effect of decaying leaves on fish survival were studied in tanks containing 7 gal of water. Although the results are preliminary and short-term, they do indicate that decomposing leaves may provide an important shield to aquatic life. Decomposing leaves seem to have the following beneficial effects: an initial drop in pH followed by an increase; after an induction period, the buffer capacity increases significantly; and decomposing leaves appear to mitigate the effects of aluminum on fish at pH 5.0, but not at pH 4.5. The effects of leaves depend on the species involved, with pine being least beneficial, causing increased acidity and poor complexation, and cypress and willow being the most effective. (Rochester-PTT)
W87-01089

MOLECULAR EPIDEMIOLOGY OF NON-O1 VIBRIO CHOLERAE AND VIBRIO MIMICUS IN THE U.S. GULF COAST REGION,
Maryland Univ. at Baltimore. School of Medicine.
For primary bibliographic entry see Field 5A.
W87-01127

DF-2 SEPTICEMIA FOLLOWING WHIRLPOOL SPA IMMERSION,
Easton Hospital, PA. Microbiology Section.
R. F. Holmes, and W. P. Kozinn.
Journal of Clinical Microbiology JCMIDW, Vol. 23, No. 3, p 627-628, March 1986. 1 tab, 11 ref.

Descriptors: *Whirlpool spas, *Septicemia, *Infection, *Population exposure, Pneumonia, Aerosols, Contamination, Inhalation, Blood, Recreation facilities.

The case of a 31-year-old man who developed DF-2 bacteremia, septic shock and pneumonia after recreational immersion in a whirlpool spa is reported. There was no history of dog bite or contact with canine secretions. The early appearance of pneumonia suggests that infection was acquired through either inhalation of an infectious aerosol or aspiration of contaminated water from the spa. (Author's abstract)
W87-01128

WHIRLPOOL-ASSOCIATED FOLLICULITIS CAUSED BY PSEUDOMONAS AERUGINOSA: REPORT OF AN OUTBREAK AND REVIEW,
Newfoundland and Labrador Public Health Labs., St. John's.
S. Ratnam, K. Hogan, S. B. March, and R. W. Butler.
Journal of Clinical Microbiology JCMIDW, Vol. 23, No. 3, p 655-659, March 1986. 2 tab, 46 ref.

Descriptors: *Whirlpool spas, *Folliculitis, *Infection, *Population exposure, Contamination, Human diseases, Recreation facilities.

An outbreak of folliculitis caused by Pseudomonas aeruginosa bacteria that occurred among guests using a whirlpool spa at a Newfoundland hotel is reported. Of the 36 persons who used the whirlpool, 72% developed folliculitis within one to five days after exposure. The attack rate was higher for children than for adults. Published reports of outbreaks of Pseudomonas folliculitis associated with the use of whirlpools, hot tubs and swimming pools are listed. The need to culture pool water for P. Aeruginosa both routinely and after suspected cases of recreationally associated folliculitis is emphasized. (Michael-PTT)
W87-01129

COMPARISON OF FATTY ACIDS AND LIPIDS OF SMOLTING HATCHERY-FED AND WILD ATLANTIC SALMON SALMO SALAR,
Canadian Inst. of Fisheries Technology, Halifax (Nova Scotia).
R. G. Ackerman, and T. Takeuchi.
Lipids LPDSAP, Vol. 21, No. 2, p 117-120, February 1986. 3 tab, 35 ref.

Descriptors: *Fatty acids, *Lipids, *Salmon, *Smolt, *Fish hatcheries, Tissue analysis, Fish diet, Growth, Oxygen requirements.

A comparison of fatty acids and lipids of hatchery-raised and wild Atlantic salmon was conducted. Analysis of healthy smolt-stage wild fish showed that whole bodies have only a quarter of the lipid of comparable hatchery fish. Comparison of fatty acids showed a higher proportion of arachidonic acid in wild fish. Results suggest that the smolt lipid may be a cause of dermal lesion or may act as a defense mechanism, possibly mediated through oxygenase activity. (Michael-PTT)
W87-01140

EFFECTS OF EXPOSURE TO SALTY DRINKING WATER IN AN ARIZONA COMMUNITY: CARDIOVASCULAR MORTALITY, HYPERTENSION PREVALENCE, AND RELATIONSHIPS BETWEEN BLOOD PRESSURE AND SODIUM INTAKE,
Centers for Disease Control, Atlanta, GA. Div. of Chronic Disease Control.
T. K. Welty, L. Freni-Titulaer, M. M. Zack, P. Weber, and J. Sippel.
Journal of the American Medical Association JAMAA, Vol. 255, No.5, p 622-626, February 7, 1986. 1 fig, 5 tab, 24 ref.

Descriptors: *Population exposure, *Drinking water, *Saline water, *Gila Bend, Sodium, Blood pressure, Health effects, Hypertension, Surveys, Calcium, Potassium.

A study was conducted to determine whether the high sodium content of Gila Bend, AZ drinking water was associated with blood pressure levels and to examine the prevalence of hypertension and hypertension mortality rates in Gila Bend with that of referent populations. Participants in a survey of Indian and non-Indian groups were interviewed for health risk factors, water consumption and dietary sodium and calcium intake. Height, weight, blood pressure and urinary sodium and potassium levels were measured. There was no evidence of a positive association betwen blood pressure and water sodium intake. The study did not evaluate the effect of high drinking water sodium on hypertensive patients, cardiac patients or those individuals who are genetically sensitive to sodium intake. (Michael-PTT)
W87-01141

HEAVY METALS IN FISH FROM A SERIES OF METAL-CONTAMINATED LAKES NEAR SUDBURY, ONTARIO,
Guelph Univ. (Ontario). Dept. of Zoology.
R. W. Bradley, and J. R. Morris.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 341-354, 1986. 1 fig, 7 tab, 53 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Fish, *Lakes, *Contamination, Ontario, Fish physiology, Fish populations, Tissue analysis, Copper, Nickel, Zinc, Perch, Pike, Bass, Sucker, Whitefish, Trout, Aquatic habitats, Water quality, Bioaccumulation.

Fish species from metal-contaminated lakes in the Sudbury region of Ontario, Canada were examined for copper, nickel and zinc content of muscle, liver and kidney tissue. Muscle tissue was a poor indicator of increased metal availability. Liver tissue was a good indicator for copper, while kidney tissue was best for nickel. Zinc levels in tissue varied little among either fish species or lakes. The presence of elevated levels of copper and nickel in liver and kidney tissues of fish from certain lakes supported the hypothesis that fish populations were stressed by metal contamination of local aquatic habitats. Although the degree of lake contamination is one factor influencing copper availability, water quality parameters may also influence bioavailability and bioaccumulation during long term exposure in the natural environment. (Michael-PTT)
W87-01142

RECOLONIZATION POTENTIAL OF METRIDIUM SENILE IN AN AREA PREVIOUSLY DEPOPULATED BY OXYGEN DEFICIENCY,
Kiel Univ. (Germany, F.R.). Water Economics and Landscape Ecology Inst.
For primary bibliographic entry see Field 2L.
W87-01144

EFFECTS OF A GLUCOSE-IMPOSED OXYGEN DEMAND ON LAND TREATMENT SYSTEMS,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
P. N. Coody, L. E. Sommers, and D. W. Nelson.
Journal of Environmental Quality JEVQAA, Vol 15, No. 1, p 16-20, January-March 1986. 2 fig, 3 tab, 21 ref.

Descriptors: *Oxygen demand, *Land disposal, *Glucose, *Plant growth, *Chemical oxygen demand, Wastewater, Water requirements, Crop yield, Municipal wastewater, Industrial wastewater.

Laboratory experiments were conducted to quantify soil and crop interactions in a land treatment system receiving a glucose-imposed oxygen demand. Synthetic wastewaters were prepared by dissolving sufficient glucose in a plant nutrient solution to provide four levels of chemical oxygen demand (COD) and applied to soil columns cropped to reed canarygrass (Phalaris arundinacea) to provide a COD of 0 to 180 mmol 02 per column per week. The columns received the glucose for 25 weeks. The added COD elevated CO2 concentrations in the soil atmosphere to more than 480 times atmospheric levels. This coincided with a depletion of 02 in the soil atmosphere, where a minimum concentration of 0.3 mol 02 per cu m was observed. Average plant yields ranged from 2.8 to 20.3 per column and were inversely proportional to the COD added. Water use ranged from 11.4 to 26.9 cm per column per week and was directly related to the reduction in plant growth caused by the COD loading. Greater than 97% of the added COD was removed by the simulated land treatment system. (Author's abstract)
W87-01156

RADIONUCLIDE UPTAKE BY TREES AT A RADWASTE POND IN WASHINGTON STATE,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
D. S. Landeen, and R. M. Mitchell.
Health Physics, Vol. 50, No. 6, p 769-774, June 1986. 1 fig, 2 tab, 18 ref.

Descriptors: *Radionuclide uptake, *Radwaste ponds, Heavy metals, Decontamination, Wastewater treatment, Radiometry, Industrial wastewater.

Rockwell Hanford Operation, Hanford, WA, studied radionuclide uptake by trees in the summer of 1980 in support of a proposed effort to decommission and decontaminate a Hanford radwaste pond. The radionuclide values were below any levels of environmental concern and were within state and federal guidelines. U-Pond had been constructed in 1944 for the surface disposal of industrial waste waters from nuclear separation processes and is supposed to be one of the longest used aquatic, low-level, radioactive waste-disposal sites in the world. Tree leaf, twig, root, core and soil samples were collected and analyzed for (137)Cs, (90)Sr and (239)Pu/(240)Pu. Strontium-90 was more readily taken up by trees than (137)Cs or (239)Pu/(240)Pu. Soil concentration values for (137)Cs and (239)Pu/(240)Pu were significantly greater ($p < or = 0.05$) than all tree component parts. For all tree components examined radionuclide concentration ratios were higher for (90)Sr (0.01-1355.0) than for (137)Cs or (239)Pu/(240)Pu. Concentration ratios for (239)Pu/(240)Pu ranged from 0.000001 to 100 and are comparable to other studies conducted at the U.S. Department of Energy's Oak Ridge and Savannah River laboratories. These data represent the first quantitative information with respect to radionuclide uptake by trees on the Hanford Site. (Khumbatta-PTT)
W87-01203

CADMIUM BIOACCUMULATION STUDIES IN THE FRESHWATER MOLLUSCS ANODONTA CYGNEA AND UNIO ELONGATULUS,
Padua Univ. (Italy). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W87-01206

REGULATION AND SUBCELLULAR DISTRIBUTION OF COPPER IN THE FRESHWATER MOLLUSCS ANODONTA CYGNEA (L.) AND UNIO ELONGATULUS (PF.),
Padua Univ. (Italy). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W87-01207

ACID RAIN EFFECTS ON SOIL AND AQUATIC MICROBIAL PROCESSES; THE ECOLOGICAL EFFECTS OF ACID DEPOSITION: PART II;
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
A. J. Francis.
Experientia EXPEAM, Vol. 42, No. 5, p 455-465, May 15, 1986. 101 ref.

Descriptors: *Air pollution effects, *Acid rain, *Ecological effects, *Microbiological studies, Rainfall, Soil bacteria, Soil fungi, Aquatic bacteria, Biotransformation, Nitrogen cycle, Ecological distribution.

A review of the literature suggests that acid rain may affect certain key processes catalyzed by soil microorganisms, such as organic matter decomposition and nitrogen transformation, and ultimately the nutrient cycling in the forest ecosystem. Studies with simulated acid rain show overall reductions in several soil microbial processes; stimulatory effects are assumed to be temporary. Little is known about the of acid rain on nitrogen transformation under field conditions, or the microbial contribution to the acidification of surface waters. Therefore, it is not clear how and at what rate the current acid precipitation is affecting soil microbial processes. Meanwhile, it is clear that increasing acidity inhibits microbial activity in the aquatic environment, inhibiting the process of decomposition. However, there is still a large gap in our knowledge of the effects of acidity on microbial processes important in the biogeochemical cycles of the lake and stream ecosystem. (Doria-PTT)
W87-01208

VEGETATION STRUCTURE AND PRIMARY PRODUCTION IN ACIDIFIED LAKES IN SOUTHWESTERN SWEDEN,
Swedish Environmental Research Inst., Fryksta.
For primary bibliographic entry see Field 2H.
W87-01209

EFFECTS OF ACID DEPOSITION ON BENTHIC ANIMALS IN LAKES AND STREAMS,
Oslo Univ. (Norway). Dept. of Biology.
J. Okland, and A. Okland.
Experientia EXPEAM, Vol. 42, No. 5, p 471-486, May 15, 1986, 20 fig, 159 ref.

Descriptors: *Benthic fauna, *Lakes, *Streams, *Air pollution effects, *Acid rain, *Bioindicators, Aquatic animals, Benthos, Fauna, Acid streams, Acid lakes, Crayfish, Crustaceans, Snails, Insects, Aquatic insects, Mollusks.

Some species of crustaceans, snails, mussels, and insects have disappeared from certain European lakes and streams with acidification of the water. For some species, experimental evidence points to a direct physiological effect of high H(+) concentration. The pH value also serves as an index for special environmental characteristics and correlates with a number of causal factors influencing the benthic fauna indirectly, although there is no absolute lower pH limit for a given species. Four theories are presented to explain why some acid lakes in North America do not have an monitor acidification. Some are more sensitive than fish and are early warning signals in the acidification process. Benthic animals serve as food for fish and birds, affect degradation rates of organic matter, and contribute to the recycling of inorganic nutrients. Changes in the benthic fauna influence the transfer of energy and elements in lake and stream environments. The quantitative aspects of these processes are poorly understood. (Doria-PTT)
W87-01210

IMPACT OF ACIDIFICATION ON PHYTOPLANKTON AND ZOOPLANKTON COMMUNITIES,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. F. M. Geelen, and S. E. W. Leuven.
Experientia EXPEAM, Vol. 42, No. 5, p 486-494, May 15, 1986. 4 fig, 99 ref.

Descriptors: *Acidification, *Acid streams, *Lakes, *Ecological effects, *Phytoplankton, *Zooplankton, Streams, Aquatic plants, Plankton, Species diversity, Biomass, Algae, Aquatic environment, Environment.

The effects of acidification on phytoplankton and zooplankton are difficult to assess because of geomorphological differences between acidifying systems and discrepancies in methods of plankton analysis. A review of the literature indicates that in general, there is a strong decrease in the diversity of phytoplankton communities in acidifying systems, whereas a few species become dominant. Although there are no clear indications for biomass of attached algae tends to increase. Limited data on zooplankton indicates a decrease in standing stock. It is evident that other environmental factors in addition to pH bring about the structural and decreased nutrient availability, changes in trophic relationships between importance of the key factors involved and the mechanism of acidification are not well elucidated. (Doria-PTT)
W87-01211

EFFECTS OF WATER ACIDIFICATION ON THE DISTRIBUTION PATTERN AND THE REPRODUCTIVE SUCCESS OF AMPHIBIANS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
R. S. E. W. Leuven, C. den Hartog, M. M. C. Christiaans, and W. H. C. Heijligers.
Experientia EXPEAM, Vol. 42, No. 5, p 495-503, May 15, 1986. 8 fig, 9 tab, 45 ref.

Descriptors: *Acidic water, *Ecological effects, *Ecological distribution, *Physiological ecology, *Amphibians, *Acid rain, Frogs, Toads, Chemical properties, Heavy metals, Aquatic fungi.

Nine amphibian species that are highly sensitive to acidifying precipitation were identified in poorly buffered waters of The Netherlands. The number of species as well as the percentage of waters which harbor amphibian populations are strongly reduced under extreme acidity (pH <4.0). The reproductive success of amphibians is negatively affected by low pH, the eggs becoming heavily infested with fungi (Saprolegniaceae). Many physico-chemical parameters in acidifying systems are significantly correlated with the pH of the water. Strongly acidified waters are correlated with the pH of the water. Strongly acidified waters are characterized by low alkalinity, conductivity, and ionic content, but high acidity and high concentrations of heavy metals and ammonium and a high relative sulfate concentration. Culture experiments with eggs and larvae of Rana arvalis, Rana 'esculenta,' Rana temporaria, and Bufo bufo show that elevated aluminum, cadmium, and ammonium contents also may affect the reproductive success of amphibians. (Doria-PTT)
W87-01212

EFFECTS OF EXPERIMENTAL ACIDIFICATION ON FRESHWATER ENVIRONMENTS,
Commission of the European Communities, Ispra (Italy). Dept. of Physical and Natural Sciences.
O. Ravera.
Experientia EXPEAM, Vol. 42, No. 5, p 507-516, May 15, 1986. 5 fig, 50 ref.

Descriptors: *Acid water, *Acid rain, *Ecological effects, *Lakes, *Streams, *Aquatic environment, Heavy metals, Sulfates, Case studies, Aquatic animals, Aquatic plants, Aquatic life, Ecosystems.

Most research on the effects of acidification has been carried out in natural ecosystems. However, during the past few years investigations have been carried out with experimental acidification in areas with a low rate of acid deposition. Experimental acidification simulates only the direct acid deposition loading and excludes the contribution from the tributaries and the watershed. However, advantages include the ability to separate the effects of direct acidification from those produced by other sources, precise knowledge of the date at which acidification began, the amount of acid introduced, the ability to regulate pH, and the ability to record early effects when buffering capacity is abolished by pH, and the ability to record high. A number of case histories are reported to illustrate the natural and artificial ecosystems. Results of these studies may clarify problems that cannot be explained by studies on environments acidified by

atmospheric deposition. Moreover, laboratory experiments are useful to separate the direct effects of acidification from their consequences. (Doria-PTT)
W87-01213

MOLECULAR VOLUMES AND THE TOXICITIES OF CHEMICALS TO FISH,
Guelph Univ. (Ontario). Dept. of Chemistry and Biochemistry.
J. C. McGowan, and A. Mellors.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 881-887, June 1986. 1 fig, 2 tab, 15 ref.

Descriptors: *Toxicity, *Fish, *Chemical properties, *Physical properties, *Effects of pollution, *Water pollution effects, Chemical reactions.

The biological activity of many compounds depends upon their physical properties. The reported toxicities of various chemicals to fish depend especially on their molecular volumes. Equations are presented to estimate toxicity based on molecular volume. Where the measured toxicity is less than the estimated toxicity, this may result from interactions of polar groups with water; appropriate corrections can be made using an interaction term. Where measured toxicity is much greater than estimated toxicity, then the toxicity is due to specific chemical interactions rather than to non-specific physical toxicity. The correlation can be used to predict the toxicity of new compounds and to design less toxic chemicals for industrial applications. It may also be useful in quantitative structure-activity relationship (QSAR) models. (Doria-PTT)
W87-01216

TOXICITY OF ZINC TO A VIVIPAROUS FISH, LEBISTES RETICULATUS (PETERS),
Vikram Univ., Ujjain (India). School of Studies in Zoology.
R. Sehgal, and A. B. Saxena.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No.6, p 888-894, June 1986. 5 tab, 14 ref.

Descriptors: *Toxicity, *Zinc, *Fish, *Lebistes, Water pollution, Heavy metals, Water pollution effects, Fish physiology, Animal physiology.

The acute toxicity of zinc sulfate to Lebistes reticulatus and sublethal toxicity to gonads was measured after long-term exposure (20 days). Bioassays were conducted with adult fish obtained near Ujjain, India. The LC50 values were 300 mg/l for males, and 278 mg/l for females. Male and female fish exposed to sublethal concentrations of zinc sulfate for 20 days exhibited profound changes in gonads. Female fish exposed to 278 mg/l of zinc displayed histological characteristics of increased percentage of atretic oocytes, reduction in percentage of mature oocytes, pyknotic nuclei, and numerous small vacuoles in cytoplasm. In male fish treated wit 300 mg/l zinc, elaborate vacuolization was observed in spermatocytes. The cysts of spermatogonia, spermatocytes, spermatids, and sperm exhibited a significant reduction in count (percentages), and there was a remarkable increase in the percentage of atretic spermatophores. There were no apparent abnormalities in control groups of either sex. These results are in good agreement with previous reports. (Doria-PTT)
W87-01217

MAGNITUDE AND DISTRIBUTION PATTERN OF ZINC IN OYSTERS,
South Carolina State Coll., Orangeburg.
A. K. Koli, R. Whitmore, and L. C. Lester.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 895-899, June 1986. 3 tab, 5 ref. USDA SEA/CR Grant SC-X-120-06-82.

Descriptors: Descriptor: *Zinc, *Oyster, *Bioindicators, Mollusks, South Carolina, Water pollution, Pollutant identification, Monitoring, Chemical analysis, Tissue analysis.

Trace element zinc in oysters from the Atlantic coast of South Carolina was determined by flame atgomic absorption analysis. The magnitude and distribution pattern of zinc is different in different sizes of oysters. Zinc levels in oysters from Mount Pleasant (whole-body weight range 2.1 to 11.2 grams) averaged 1.27 mg/kg (range 1.562 to 0.49 mg/kg). Zinc levels in oysters from Charleston (1.2 to 9.5 g) averaged 0.905 mg/kg (range 1.573 to 0.315 mg/kg). Zinc level,s in oysters from Beaufort (0.7 to 7.9 g) averaged 0.618 mg/kg (range 1.386 to 0.128 mg/kg). Oysters were found to contain higher zinc levels than other shellfish species, shrimp, crab, scallop, and squid, although the zinc levels found in these oysters were not high enough to render them dangerous for human consumption. (Doria-PTT)
W87-01218

TRACE METAL EXPORT IN URBAN RUNOFF AND ITS BIOLOGICAL SIGNIFICANCE,
Water Research Center, Canberra (Australia).
For primary bibliographic entry see Field 5B.
W87-01219

HISTOPATHOLOGICAL EFFECTS OF COPPER ON SELECTED EPITHELIAL TISSUES OF SNAILS,
Potchefstroom Univ. for C.H.E. (South Africa). Dept. of Zoology.
C. T. Wolmarans, W. J. van Aardt, and J. Coetzee.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 906-911, June 1986. 4 fig, 9 ref.

Descriptors: *Histology, *Pathology, *Copper, *Tissue analysis, *Snails, *Water pollution effects, Bulinus, Toxicity, Heavy metals, Mollusks.

Histological changes in the surface epithelium of the snail Bulinus tropicus were investigated by transmission electron microscopy after exposure to copper sulfate (1 mg/kg for six hours). Tissue damage occurred in both the tentacle and head epithelium. Changes were marked in the area of the basal lamina, where the connective tissue either swelled or pulled away from the basal lamina. These spaces showing no electron density were remarkably large. The largest vacuole in the tentacle epithelium was 10.46 microns in diameter, while in the head epithelium, between the basal lamina and the subjacent connective tissue, the largest vacuole had a diameter of 4.5 microns. It is concluded that copper probably adsorbs to all exposed tissues of the snail, and that the same histological changes will occur in all epithelia; selective adsorption of copper with selective tissue damage is therefore unlikely. These histological changes probably result in physiological disturbances that have been reported. (Doria-PTT)
W87-01220

OXYGEN UPTAKE BY EXCISED GILLS OF PROCAMBARUS CLARKII (GIRARD) FROM ALBUFERA LAKE OF VALENCIA, SPAIN, UNDER HEAVY METAL TREATMENTS,
Valencia Univ. (Spain). Dept. of Animal Physiology.
J. Diaz-Mayans, A. Torreblanca, J. Del Ramo, and A. Nunez.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 912-917, June 1986. 3 tab, 17 ref.

Descriptors: *Procambarus, *Oxygen uptake, *Gills, *Lakes, *Valencia, Spain, *Crayfish, *Water pollution effects, Crustaceans, Chromium, Cadmium, Mercury.

Gills were excised from adult American red crayfish (Procambarus clarkii) and exposed to chromium, cadmium, and mercury. Oxygen consumption of gill tissue decreased as concentration of hexavalent chromium increased. Oxygen uptake rates increased in gill tissue treated with low concentrations of cadmium (3.2 and 32 micrograms per liter), but decreased at a Cd concentration of 1 mg/l. Oxygen consumption rates increased as mercury concentration increased. However, none of these results were significant when analyzed by the ANOVA test ($p > 0.05$). Mercury showed the highest toxic effects of the three metals tested, inducing death of all animals exposed to 1.5 mg/l. (Doria-PTT)
W87-01221

METABOLIC ACTIVITIES IN FLOCCULENT SURFACE SEDIMENTS AND UNDERLYING SANDY LITTORAL SEDIMENTS,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
For primary bibliographic entry see Field 5B.
W87-01230

METABOLIC REGULATION OF AMINO ACID UPTAKE IN MARINE WATERS,
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 2L.
W87-01231

REACTIVITY OF METALS FOR MARINE PHYTOPLANKTON,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5B.
W87-01233

AQUATIC PLANTS OF ACID LAKES IN KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA; FLORISTIC COMPOSITION AND RELATION TO WATER CHEMISTRY,
Department of Agriculture, Ottawa (OntariO0
P. M. Catling, B. Freedman, C. Stewart, J. J. Kerekes, and L. P. Lefkovitch.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 4, p 724-729, April 1986. 1 fig, 5 tab, 22 ref.

Descriptors: *Lakes, *Acid rain, *Water pollution effects, *Acidic water, *Aquatic plants, Water quality, Kejimkujik National Park, Nova Scotia, Macrophytes, Color, Bicarbonates, Hydrogen ion concentration, Calcium.

To document the aquatic flora of acid lakes in Kejimkujik National Park, N.S., the presence and abundance of aquatic macrophytes growing in water deeper than 3 dm were recorded in 20 lakes. Of the 45 species found, the most important were Sphagnum macrophyllum, Eriocaulon septangulare, Utricularia purpurea, Scirpus subterminalis, Pontederia cordata, Nuphar variegatum, Nymphaea odorata, Eleocharis acicularis, Sparganium angustifolium, Potamogeton confervoides, Lobelia dortmanna, Potamogeton epihydrus, and Utricularia vulgaris. To explore the relationship between floristic composition and water chemistry, information on 12 chemical variables and color was related to species presence-absence using a nonparametric test based on relative neighborhood graphs. Analyses of variance (ANOVAs) using chemical data and six groups suggested by a conditional clustering of the species presence-absence data demonstrated significant heterogeneity in Ca, pH, and HCO3. Furthermore, these three proved to be highly correlated. A canonical variate analysis of the six groups revealed one significant axis and separated the lakes into two major groups, characterized by relative acidity. An ANOVA of these two groups established that color was also significant. There were fewer species in the more acidic (range 8-20, average 15) than in the less acid lakes (range 15-32, average 22). (Author's abstract)
W87-01234

INVESTIGATIONS OF THE MARINE ALGAE OF NOVA SCOTIA. XVI. THE OCCURRENCE OF SMALL GREEN ALGAE,
Copenhagen Univ., Frederikshavn (Denmark). Afd. Havbiologisk.
For primary bibliographic entry see Field 2L.
W87-01236

EFFECTS OF DEICING SALTS ON VEGETATION IN PINHOOK BOG, INDIANA,
Indiana Dunes National Lakeshore, Porter, IN.
D. A. Wilcox.

Canadian Journal of Botany CJBOAW, Vol. 64, No. 4, p 865-874, April 1986. 3 fig, 4 tab, 66 ref.

Descriptors: *Water pollution effects, *Roads, *Bogs, *Saline water, *Deicers, Vegetation, Trees, Wetlands, Vegetation effects, Peat, Plant populations, Pinhook Bog, Indiana, Sphagnum, Cattails, Salt tolerance.

An uncovered road salt storage pile, located next to Pinhook Bog for 10 years, produced contamination which affected the bog vegetation. Nearly all of the endemic plant species (excluding moat species) were absent from the portion of the bog where mean salt concentrations as high as 468 mg/liter sodium and 1215 mg/liter chloride were measured in the interstitial waters of the peat mat. Skeletons of dead tamaracks with invading cattails and other nonbog species were evident. Over the 4-year study salt concentrations decreased by 50%, and the vegetation composition changed. Some of the invading populations (such as cattails) declined; others continued expansion. During this period many of the endemic bog plants, including Sphagnum, returned to the impacted area. The species present at the end of the study (1983) were salt tolerant and pioneers in secondary succession of disturbed bogs. (Cassar-PTT)
W87-01237

NOVEL TRANSMISSIBLE FACTORS IN A NON-OL VIBRIO CHOLERAE AND A VIBRIO SP.,
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W87-01240

ACCUMULATION OF CADMIUM BY WHITE SUCKERS (CATOSTOMUS COMMERSONI) IN RELATION TO FISH GROWTH AND LAKE ACIDIFICATION,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W87-01246

LARGE-SCALE RISK ASSESSMENT OF ACID RAIN IMPACTS ON FISHERIES: MODELS AND LESSONS,
Canada Centre for Inland Waters, Burlington (Ontario).
C. K. Minns, J. R. M. Kelso, and M. G. Johnson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 900-921, April 1986. 10 fig, 10 tab, 64 ref.

Descriptors: *Water pollution effects, *Acid rain, *Fisheries, Precipitation, Lakes, Streams, Watersheds, Neutralization, Aquatic habitats, Habitats, Model studies, Water quality, HSM-H models, ESSA models.

Lakes, streams, and their watersheds in large parts of the world have little ability to neutralize acidity associated with precipitation. Resource management agencies are concerned with the extent of these impacts including the loss/hazard to key fish species, and the likely status of these aquatic systems given alternate emission control scenarios. Two models designed to provide such a large-scale risk assessment are presented herein. The strengths and weaknesses are identified. These are compared with existing knowledge, theories, and data. (Author's abstract)
W87-01250

EFFECTS OF LOW PH AND OTHER CHEMICAL VARIABLES ON THE LOCAL DISTRIBUTION OF AMPHIBIANS,
Pennsylvania State Univ., University Park. Dept. of Biology.
J. Freda, and W. A. Dunson.
Copeia, No. 2, p 454-466, May 1986. 9 tab, 43 ref. DOI FWS Cooperative Agreement 141600091548.

Descriptors: *Water pollution effects, *Acid rain, *Acidic water, *Hatching, Amphibians, Ponds, Frogs, Toads, Salamanders, Jefferson salamanders, Fowler's toads, Wood frogs, Pine barrens treefrogs, Treefrogs, Aquatic habitats, Habitats, New Jersey, Pennsylvania, Embryonic growth stage.

The effect of low environmental pH on amphibians was studied in central Pennsylvania and the New Jersey Pine Barrens. Jefferson salamander (Ambystoma jeffersonianum) and Fowler's toad (Bufo woodhousei) embryos were intolerant of low pH and were absent from the most acidic ponds. Wood frog (Rana sylvatia) and pine barrens treefrog (Hyla andersoni) embryos were tolerant and found in ponds with the lowest pHs. Laboratory tests demonstrated that A. jeffersonianum could not hatch below pH 4.50, whereas R. sylvatica could hatch even at pH 4.25. Similarly, B. woodhousei could not hatch below pH 4.10, but H. andersoni could hatch at pH 3.70. Embryos of all four species were transplanted into several ponds ranging in pH from 3.90-7.06 to test whether embryonic mortality caused by low pH could be responsible for the absence of the two least tolerant species from acidic ponds. Hatching of embryos of R. sylvatica was not related to pH while mortality of embryos of A. jeffersonianum increased significantly as pond pH declined. H. andersoni also hatched in all experimental New Jersey ponds, but embryos of B. woodhousei suffered significantly higher mortality in ponds of lower pHs. Hatching success was variable at specific pond pHs, indicating significant interaction of pH with other chemical variables. In laboratory trials tadpoles of B. woodhousei and H. andersoni grew significantly slower when exposed to low pH. This sublethal effect on body size has important implications for dynamics of amphibians populations in acidic ponds. (Author's abstract)
W87-01255

INFLUENCE OF LEAD ON CHLAMYDOMONAS REINHARDII DANEGARD (VOLVOCALES, CHLOROPHYTA): ACCUMULATION, TOXICITY AND ULTRASTRUCTURAL CHANGES,
Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik.
U. Irmer, I. Wachholz, H. Schafer, and D. W. Lorch.
Environmental and Experimental Botany EEBODM, Vol. 26, No. 2, p 97-105, April 1986. 11 fig, 1 tab, 29 ref.

Descriptors: *Water pollution effects, *Lead, *Toxicity, *Accumulation, *Algae, Bioaccumulation, Aquatic habitats, Aquatic plants, Chlamydomonas, Heavy metals, Metals.

Cell suspensions of Chlamydomonas reinhardii obtained from continuous cultures were exposed under batch culture conditions to various concentrations of lead. Photosynthetic oxygen evolution, chlorophyll content, dry weight and lead accumulation were determined. Exposure to 1 microM Pb in the medium for 3 hours caused a marked reduction in net photosynthesis. A reduction of approximately 50% (ED50) was obtained with 5 microM Pb. Exposure of the alga for 24 hours to 20 microM Pb was lethal. The amounts of lead accumulated within 24 hours by algae exposed to external metal concentrations of 1, 5 and 20 microM Pb were 26.3, 99.1 and 339.3 microM Pb/g of dry weight, respectively. Contaminated algal material obtained by exposure to lead at the toxic level of 5 microM, was examined by transmission electron microscopy. Lead caused drastic ultrastructural damage: the thylakoid systems of the chloroplast were disarranged and showed a fingerprint-like appearance. Stigmata were missing or only partially present. Changes were observed in nuclear and mitochrondrial structure. The number of lipid bodies was increased whereas starch granules were generally absent. Using the EDX technique deposits of lead were found in the cell wall, the chloroplast, the remaining part of the stigma, and the vacuole. (Author's abstract)
W87-01258

COMBINED EFFECTS OF SIMULATED ACID RAIN AND OZONE ON INJURY, CHLOROPHYLL, AND GROWTH OF RADISH,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Johnson Jr., D. S. Shriner, and C. K. Kinerley.
Environmental and Experimental Botany EEBODM, Vol. 26, No. 2, p 107-113, April 1986. 5 tab, 29 ref. EPA Interagency agreement 40-1364-83; DOE Contract DE-AC05-840R21400.

Descriptors: *Water pollution effects, *Acid rain, *Ozone, *Plant growth, Precipitation, Rainfall, Radish, Chlorophyll, Toxicity.

Radish plants (Raphanus sativus L. cv Scarlet Globe) were exposed to 0.0, 0.1, 0.2, or 0.4 ppm of ozone(03) for 3 hr once per week for 3 weeks and simulated rain acidified to pH 5.6, 4.0, 3.3, or 3.0 four times in a replicated 4 squared factoral design. The threshold concentration of 03 for induction of visible injury was between 0.1 and 0.2 ppm. The threshold level of acidity for visible injury was between pH 4.0 and 3.3. The combined effect of 03 and acidic rain was primarily additive. However, younger leaves (positions 3-5) exhibited an antagonistic injury response (significant only for leaf 5) to the treatment that included pH 3.3 rain and 0.4 ppm of 03. Also, there was a tendency for older leaves (positions 1 and 2) exposed to acid rain to be more sensitive to 0.4 ppm of 03 than those exposed to pH 5.6 rain. Hypocotyl dry weight and foliar chlorophyll were significantly reduced by 03. Acid rain and the interaction of 03 and acid rain had no effect on hypocotyl or foliage dry weight or foliar chlorophyll content. These results indicated that radish plants under these culture methods exhibited primarily additive responses to combinations of 03 and acid rain. (Author's abstract)
W87-01259

FOLIAR UPTAKE OF 15-N FROM RAIN,
Manhattan Coll., Bronx, NY. Lab. of Plant Morphogenesis.
L. S. Evans, D. C. Canada, and K. A. Santucci.
Environmental and Experimental Botany EEBODM, Vol. 26, No. 2, p 143-146, April 1986. 1 tab, 15 ref.

Descriptors: *Water pollution effects, *Acid rain, *Nitrogen, Plant growth, Precipitation, Rainfall, Fertilizers, Beans.

Acid precipitation has elevated concentrations of nitrogen and sulfur which may be incorporated into plant foliage which could, in turn, increase plant productivity. The purpose of the research reported herein was to determine if N in simulated rainfalls, equivalent to the highest known N concentrations found in acidic precipitation can significantly increase the N concentration of foliage of a herbaceous crop by a foliar uptake mechanism. Although N inputs were greater in leaves of Phaseolus vulgarus L. exposed to simulated rainfalls of high acidity, the relationship between N content in rain and N content in leaves, as determined by N15/N14 mass spectrometric analyses was relatively insignificant to plant productivity. Three simulated rainfalls of pH 4.0 which provided 1.38 cm of water contributed from 4.6 to 47 micrograms N while such rainfalls at pH 3.4 provided 17 to 34 micrograms N per leaflet. These amounts are relatively insignificant compared with 45 to 55 mg N per g tissue present in beam leaves. These results coupled with results of other experiments support the conclusion that ambient N deposition rates do not significantly affect yields of agricultural crops. (Author's abstract)
W87-01260

PHYSIOLOGICAL RESPONSES TO ACID STRESS IN CRAYFISH (ORCONECTES): HAEMOLYMPH IONS, ACID-BASE STATUS, AND EXCHANGES WITH THE ENVIRONMENT,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
C. M. Wood, and M. S. Rogano.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 5, p 1017-1026, May 1986. 7 fig, 2 tab, 42 ref.

Descriptors: *Physiological effects, *Acid rain, *Crayfish, *Acidic water, *Radioisotopes, Teleosts, Anions, Cations, Orconectes, Acidosis.

Exposure of crayfish (Orconectes) for 5 days to pH = 4.0 in decarbonated software caused a severe metabolic acidosis and a moderate expression of Na(+) and Cl(-) in the hemolymph. Lactate did not accumulate. Acidosis was caused by a large uptake of acidic equivalents from the environmental water; more than 95% was stored outside the extracellular compartment. Hemolymph Na(+) fell more than Cl(-) because of greater net losses to the water. Unidirectional flux analyses with radiotracers demonstrated that negative net Na(+) and Cl(-) balance resulted from partial inhibition of influx components; effluxes were little affected. All flux effects were reversible. At a mechanistic level, the responses of crayfish to acid stress appear very different from those of teleost fish. (Alexander-PTT)
W87-01273

SHORT-TERM VARIATIONS IN THE PIGMENT COMPOSITION OF A SPRING PHYTOPLANKTON BLOOM FROM AN ENCLOSED EXPERIMENTAL ECOSYSTEM,
Institute of Oceanographic Sciences, Wormley (England).
P. S. Ridout, and R. J. Morris.
Marine Biology MBIOAJ, Vol. 87, No. 1, p 7-11, June 1985. 5 fig, 24 ref.

Descriptors: *Lakes, *Eutrophication, *Carotenoids, *Limiting nutrients, *Limnology, *Chlorophyll, Phytoplankton, Chromotography, Nutrients, Algae, Ecosystems, Limnology, Lake sediments, Scotland, Lock Ewe.

Phytoplankton samples taken during the spring bloom in the experimental enclosed ecosystem bags at Loch Ewe, Scotland, during 1983 were analyzed for carotenoids and chlorophyll compounds using high-performance liquid-chromatography (HPLC). Changes in the relative proportions of these pigments were related to day-to-day changes in the composition of the bloom and the physiological state of the algae. There is clear evidence for a change in the chlorophyllide a: chlorophyll a ratio, which reached a maximum as nutrient limitation occurred. No major qualitative changes in the carotenoid components were seen during the bloom; the relative proportion, however, of some carotenoids does provide useful information on the relative abundance of certain algal types in the phytoplankton. (Author's abstract)
W87-01275

SHALLOW-WATER BENTHIC AND PELAGIC METABOLISM: EVIDENCE OF HETEROTROPHY IN THE NEARSHORE GEORGIA BIGHT,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2L.
W87-01276

BRANCHIAL NA(+)-K(+)-ATPASE ACTIVITY DURING OSMOTIC ADJUSTMENTS IN TWO FRESHWATER EURYHALINE TELEOSTS, TILAPIA (SAROTHERODON MOSSAMBICUS) AND ORANGE CHROMID (ETROPLUS MACULATUS),
Wilson Coll., Bombay (India). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W87-01277

EFFECTS OF EUTROPHICATION ON REEF-BUILDING CORALS: I. GROWTH RATE OF THE REEF-BUILDING CORAL MONTASTREA ANNULARIS,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
T. Tomascik, and F. Sander.
Marine Biology MBIOAJ, Vol. 87, No. 2, p 143-155, July 1985. 4 fig, 14 tab, 53 ref.

Descriptors: *Corals, *Eutrophication, *Water pollution effects, *Water quality, *Reefs, Photosynthesis, Ecological effects, Suspended solids, Coelenterates, Growth, Environmental effects, Barbados.

Fourteen environmental variables were monitored at seven locations along the west coast of Barbados on a weekly basis over a one-year period, 1981 to 1982. The physicochemical and biological data indicate that an environmental gradient exists as a result of increased eutrophication of coastal waters. Growth rates (linear extension) of Montastrea annularis (Ellis and Solander), measured along the environmental gradient, exhibit high correlation with a number of water quality variables. Concentration of suspended particulate matter is the best univariate estimator of M. annularis skeletal extension rates. The results suggest that suspended particulate matter may be an energy source for reef corals, increasing growth up to a certain maximum concentration. After this, reduction of growth occurs due to smothering, reduced light levels and reduced zooxanthellae photosynthesis. (Author's abstract)
W87-01278

UTILIZATION OF ENERGY-CHARGE, ETS AND 14-C ASSIMILATION MEASUREMENTS FOR THE STUDY OF MICROPLANKTONIC ACTIVITY IN COASTAL WATERS UNDER THE INFLUENCE OF URBAN SEWAGE (UTILISATION DES MEASURES DE CHARGE ENERGETIQUE, D'ETS ET DE C-ASSIMILATION POUR LE SUIVI DE L'ACTIVITE MICROPLANCTONIQUE DANS DES EAUX COTIERES SOUS L'INFLUENCE DE REFETS URBAINS),
Endoume Marine Station and Oceanography Centre, Marseille (France).
J. C. Romano, and A. Navarro.
Marine Biology MBIOAJ, Vol. 87, No. 3, p 229-238, July 1985. 2 fig, 5 tab, 41 ref. Ministry of the Environment (France) Contract 80-009; Ville de Marseille 80-240.

Descriptors: *Plankton, *Water pollution effects, *Marine bacteria, *Aquatic populations, Coastal waters, Ecological effects, Bacteria, Wastewater, Outlets, Environmental effects, Nutrients, Biomass, Assimilative capacity, Mediterranean Sea.

The effect of sewage from Marseilles upon marine microplanktonic assemblages was studied for 1 yr from May 1980 to April 1981 at five stations and three sampling depths. Measurements of the 14-C assimilation rate, adenylate energy charge, and the electron-transport system (ETS) were compared with parallel phytoplankton and bacteria counts. In the coastal waters near the sewage outlet, the phytoplanktonic organisms were stessed and showed intense heterotrophic activity, most probably of bacterial origin. Water situated 4 to 5 km away from the outlet showed a predominantly living phytoplanktonic assemblage. Simultaneous consideration of biochemical and physiological data with the structure and composition of the microplanktonic populations could explain the apparent contradiction between the high level of nutrient supply and the lack of photoautotrophic growth noted in previous studies in this area. The considerable amounts of fresh organic matter present in the waters near the sewage outlet at Cortiou indicate the necessity for great care in the use of biochemical parameters such as chlorophyll or AMP for the estimation of microplankton biomass; such estimates can be biased by the presence of non-degraded detrital particles of biological origin. (Geiger-PTT)
W87-01280

PHOTOSYNTHETIC AND CELLULAR PHOTOADAPTIVE CHARACTERISTICS OF THREE ECOTYPES OF THE MARINE DIATOM, SKELETONEMA COSTATUM (GREV.) CLEVE,
City Coll., New York. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W87-01286

EVALUATION OF FILAMENTOUS ALGAE AS BIOMONITORS OF METAL ACCUMULATION IN SOFTWATER LAKES: A MULTIVARIATE APPROACH,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5A.
W87-01290

CYANOPHAGE ASSAY AS A NEW CONCEPT IN THE STUDY OF ENVIRONMENTAL TOXICITY,
Algal Research Center, Landenberg, PA.
For primary bibliographic entry see Field 5A.
W87-01291

DIETS FOR CERIODAPHNIA RETICULATA LIFE-CYCLE TESTS,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W87-01292

EFFECT OF DIET ON THE SENSITIVITY OF DAPHNIA MAGNA TO LINEAR ALKYLBENZENE SULFONATE,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
M. J. Taylor.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 53-72 2 fig, 10 tab, 27 ref.

Descriptors: *Daphnia, *Diets, *Bioindicators, *Toxicity, *Linear alkyl sulfonates, *Water pollution effects, Detergents, Surfactants, Sulfonates, Ecological effects.

Laboratory cultures of Daphnia magna were maintained in hard well water and fed one of five different diets. Algal diets, trout chow diets, and diets combining algae and trout chow were evaluated. The acute toxicity (48-hr LC 50) of C sub 11.8 LAS (linear alkylbenzene sulfonate) to D. magna reared on the five different diets ranged between 3.6 and 4.7 mg/L. For daphnids that were fed during the acute test, the LC50s ranged between 4.4 and 8.1 mg/L LAS. The addition of food to the acute test generally increased the LC50. Diet had a statistically significant effect on the sensitivity of D. magna to the chronic toxicity of LAS. Chronic no-observed effect concentrations (NOECs) varied about three-fold (1.2 to 3.2 mg/L) and 21-day LC50s about two-fold (2.2 to 4.7 mg/L) for daphnids fed the five diets. Survival was generally the most sensitive indicator of chronic effects. Food concentration also had a significant effect on the response of D. magna to the chronic effects of LAS. Daphnia cultures receiving lower concentrations of food were less sensitive to LAS than Daphnia cultures receiving higher food concentrations. Diet had at most a three-fold effect on the results of Daphnia toxicity tests. A three-fold variability can be expected in Daphnia toxicity tests themselves. Therefore use of any of the diets in this study should not affect the utility of the test results in assessing the environmental effects of detergent chemicals such as LAS. (Author's abstract)
W87-01293

STUDY OF THE RELIABILITY OF DAPHNIA ACUTE TOXICITY TESTS,
Environmental Protection Agency, Cincinnati, OH. Aquatic Biology Section.
For primary bibliographic entry see Field 5A.
W87-01294

SHORT-CUT CHRONIC TOXICITY ESTIMATES USING DAPHNIA MAGNA,
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W87-01295

NEW AQUATIC BIOASSAY TECHNIQUE USING WYEOMYIA SMITHII, THE PITCHER-PLANT MOSQUITO,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5A.
W87-01296

EFFECTS OF SMALL FISH PREDATION ON MICROCOSM COMMUNITY BIOASSAYS,
Washington Univ., Seattle. School of Fisheries.

For primary bibliographic entry see Field 5A.
W87-01297

FACTORS AFFECTING GROWTH AND SURVIVAL OF THE ASIATIC CLAM, CORBICULA SP., UNDER CONTROLLED LABORATORY CONDITIONS,
Battelle Pacific Northwest Labs., Richland, WA.
D. D. Dauble, D. S. Daly, and C. S. Abernethy.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia 1985. p 134-144. 2 fig, 3 tab, 22 ref. DOE Office of Health and Environmental Research Contact DE-ACO6-76RLO 1830.

Descriptors: *Clams, *Growth, *Diets, *Water temperature, *Toxicity, *Water pollution effects, *Bioindicators, Water quality, Models, Phytoplankton, Multivariate analysis, Animal physiology, Ecological effects.

Growth of Asiatic clams (Corbicula sp.) was determined in relation to food supply, water temperature, and clam size as an aid to researchers conducting chronic effects toxicity studies. Mean initial sizes (shell length) of clam groups were small (12 mm), medium (20 mm), and large (28 mm). Water temperatures for the two 84-day test series were 10, 30, and 30 C. Linear models provided good relationships between clam shell length, total weight, and wet/dry tissue weights. Clam growth was minimal during low phytoplankton densities (approximately 300 cells/mL), and all three size groups lost weight at 20 and 30 C. Mortality of small clams at 30 C was 100% after 71 days. At phytoplankton densities greater than 100 cells/mL, overall differences in growth with respect to clam size and temperature were detectable at $p > 0.01$; growth of all clam groups was greatest at 30 C. Small clams exhibited the greatest absolute increase in mean shell length at all test temperatures and their weight gains were similar to those of medium and large clams. Clams in well water that were fed trout chow at 117 mg/mL dry weight had an estimated conversion efficiency of 2.0%. Use of individual marks and multivariate analysis techniques decreased sample size and test duration needed to detect differences in Corbicula growth. (Author's abstract)
W87-01298

METHOD FOR EARLY LIFE-STAGE TOXICITY TESTS USING THREE ATHERINID FISHES AND RESULTS WITH CHLORPYRIFOS,
Environmental Research Lab., Gulf Breeze, FL.
L. R. Goodman, D. J. Hansen, D. P. Middaugh, G. M. Cripe, and J. C. Moore.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 145-154, 3 tab, 21 ref.

Descriptors: *Toxicity, *Fish, *Chlorpyrifos, *Insecticides, *Water pollution effects, Pesticides, Salinity, Biological magnification, Ecological effects.

Methods for obtaining embryos and conducting early life-stage toxicity tests (continuous exposure from the embryonic stage to approximately three weeks or more into the exogenous feeding stage) were developed for three estuarine species of atherinid fish. Early life-stage tests were conducted for 28 days with Menidia beryllina, M. menidia, and M. peninsulae exposed to 0.12, 0.25, 0.50, 1.0 and 2.0 micrograms chlorpyrifos/liter. Responses of the three species were similar: upper chronic values ranged from 0.48 to 1.8 micrograms chlorpyrifos/liter and lower chronic values ranged from 0.28 to 0.75 micrograms/liter. Chlorpyrifos exposure did not affect survival of embryos to hatching which averaged 91 to 93% for each species. In treatments in which no adverse effects were observed, combined survival of M. menidia embryos and hatched fish averaged 51% and fish weights averaged 23 mg; for M. peninsulae, 69% and 13.5 mg; and for M. beryllina, 81% and 8.7 mg. Chlorpyrifos bioconcentration factors averaged 220 for beryllina, 460 for M. peninsulae, and probably <420 for M. minidia. From these three atherinids, toxicologists may select an Atlantic or Gulf Coast species that occurs in either high or low salinity. (Author's abstract)
W87-01299

USE OF BIOCHEMICAL MEASUREMENTS TO DETECT POLLUTANT-MEDIATED DAMAGE TO FISH,
Battelle New England Marine Research Lab., Duxbury, MA.
J. M. Neff.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 155-183. 6 tab, 174 ref.

Descriptors: *Fish physiology, *Water pollution effects, *Bioindicators, *Enzymes, *Fish toxins, Hazardous materials, Fish populations, Animal tissues, Pollutant identification, Bioassay, Biochemistry, Biochemical tests, Biochemical characteristics, Ecological effects, Blood, Amino acids.

The use of enzyme activity or concentration of biochemicals in the tissues to detect pollutant stress in fish is reviewed. Of the many biochemical parameters which have been measured, most are of limited value at present, primarily because correlations between biochemical effects and significant deleterious effects in the fish population have not been established. Characteristics of the metallothionein and mixed-function oxygenase systems and activity of acetylcholinesterase and delta amino levulinic acid dehydratase in fish tissues or blood may be useful for identifying fish which have been exposed to particular classes of pollutants. Some blood enzymes and biochemicals are useful for diagnosing liver damage in fish. Biochemical composition and concentrations in the blood and tissues of fish from polluted habitats differ in characteristic ways from those of fish of the same species from nearby clean areas. Some of these differences show promise for use in assessing damage to fish populations. (Author's abstract)
W87-01300

EFFECT OF IRON AND ZINC INTERACTION ON ALGAL COMMUNITIES,
Illinois State Water Survey, Peoria. Water Quality Section.
W. Wang.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 187-201. 11 fig, 5 tab, 17 ref.

Descriptors: *Iron, *Zinc, *Wastewater, *Toxicity, *Algae, *Bioassay, Water pollution effects, Synergistic effects, Growth, Eutrophication, Heavy metals, Hazardous materials, Toxins, Ecological effects, Illinois.

The effect of iron and zinc interaction on the growth of algal communities was examined in algal samples from three sources - Peoria, Farmington, and Princeton, Illinois wastewater. In general, zinc was much more toxic than iron to algal communities. In the case of Peoria wastewater samples, the effect of iron and zinc interaction was noninteractive in one case, and antagonistic in another. In the case of the Farmington wastewater samples, iron and zinc were noninteractive against algal growth. In the Princeton wastewater samples, iron and zinc were synergistic in antagonizing algal growth. The interaction of pollutants, as well as variables inherent in organisms (e.g., species, ages, adaptation, nutrition, environment) should be considered in designing toxicity bioassays. (Geiger-PTT)
W87-01301

COMPARISON OF SYSTEM DESIGN AND REPRODUCIBILITY TO ESTIMATE BIOCONCENTRATION OF DI-N-HEXYLPHTHALATE BY DAPHNIA MAGNA,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
S. P. Gloss, and G. R. Biddinger.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 202-213. 4 fig, 1 tab, 26 ref. EPA Interagency Agreement AD-14-8-0-183-0.

Descriptors: *Daphnia, *Biological magnification, *Toxicity, *Organic compounds, *Testing procedures, Ecological effects, Comparison studies, Design criteria, Water pollution effects, Algae, Diets, Crustaceans, Models, Food chains, Sunfish, Ecosystems.

Duplicate flow-through exposure systems were used to compare the bioconcentration factors (BCFs) of 14-C-di-n-hexylphthalate (14-C-DHP) by Daphnia magna under single-species (modular) or multispecies (mixed) model formats. DHP was provided in water only to Daphnia fed unlabeled algae, in water only, and in water plus food (labeled algae) or in food only. Water levels of 14-C-DHP were maintained at approximately 0.22 micrograms/L. Algae contained approximately 0.11 micrograms/L 14-C-DHP/g. Results at 24 hr showed significantly higher accumulation of C-14-DHP in Daphnia exposed to the combination of contaminated food and water than any other treatment. Accumulation from exposures only to food was not different from controls. No differences were detected between the same treatments in the duplicate exposure systems. Exposures to C-14-DHP in water only (Daphnia fed) were conducted in a mixed model system wherein Daphnia were subjected to controlled predation by bluegill sunfish. Results from the mixed model systems suggested that steady-state accumulation took longer than seven days to achieve. Measured BCFs for the water only (48 hr), food plus water (48 hr), and the mixed model system (14 days) were 1066, 1486, and 3254, respectively. Calculated BCFs, using a first-order steady-state equilibrium model were 998, 1414, and 4655, respectively, for the same three treatments. All BCFs reported are for total 14-C activity on a wet-weight basis. (Geiger-PTT)
W87-01302

SEDIMENT MICROBIAL ACTIVITY TESTS FOR THE DETECTION OF TOXICANT IMPACTS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
G. A. Burton, and G. R. Lanza.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 214-228. 2 fig, 4 tab, 42 ref.

Descriptors: *Lake sediments, *Toxicity, *Microbial studies, *Arsenic compounds, *Bioassays, Microorganisms, Enzymes, Ecological effects, Water pollution effects, Bacteria, Biomass, Testing procedures, Assays, Environmental effects.

Sediments from six diverse lake sites were spiked with arsenic species, and effects on microbial activity were studied with a battery of tests measuring dehydrogenase (TTC), acridine orange direct counts (AODC), formazan crystal production (INT), phosphatase, proteolysis, total direct counts (DC), direct viable counts (DVC), and total plate counts (TPC). Oxygen, sediment age and volume, incubation time, diluent type, nutrient amendment, and agitation were studied as major variables. Phosphatase and TTC activity were higher in microaerobic sediment microcosms. DVC accurately detected microbial activity in water but not in sediments. INT assays revealed that sediments contain higher percentages of dormant bacteria than overlying waters. Arsenic generally failed to suppress enzyme activity in nutrient-stimulated sediments. TTC, phosphatase, and INT activity showed variable responses to arsenic additions, depending on test conditions. Proteolysis was suppressed by arsenite under aerobic conditions after one month. Sediment bacterial isolates were not sensitive to arsenate, but they were very susceptible to arsenite. The use of several microbial activity tests best described the degree of stimulation or inhibition in sediment toxicology. The diverse and complex nature of typical sediments requires careful pretesting before accurate activity bioassays can be conducted. (Author's abstract)
W87-01303

COMPARATIVE TOXICITY OF WHOLE AND LIQUID PHASE SEWAGE SLUDGES TO MARINE ORGANISMS,
EA Engineering, Science, and Technology, Inc., Sparks, MD.
J. A. Fava, J. J. Gift, A. F. Maciorowski, W. L. McCulloch, and N. J. Reisinger.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 229-252. 3 fig, 4 tab, 21 ref.

Descriptors: *Sludge, *Wastewater, *Water pollution effects, *Marine animals, *Digested sludge, Ecological effects, Toxicity, Hazardous materials, Pesticides, Organic compounds, Metals, Nutrients, Suspended solids.

The chemical composition and acute toxicity of whole digested municipal sewage sludges from twelve water pollution control plants were collected, fractionated, and analyzed. The chemical composition and acute toxicity of whole sewage sludges were compared with those of liquid sewage sludge phases. The chemical constituents analyzed included nutrients, conventional parameters, and U.S. Environmental Protection Agency consent decree priority pollutants. Results indicated that most toxic constituents were associated with suspended solids and were therefore dramatically reduced in the liquid phase sludge fractions. Despite the dramatic reduction of metals, pesticides, and other organic compounds in the liquid sludge phases, there was a distinct trend towards equivalent phase toxicity to Atlantic silversides (Menidia menidia) and grass shrimp (Palaemonetes pugio). However, whole sludges were generally more toxic to mysids (Mysidopsis bahia) than were the liquid phase sludges. Evidence to support the hypothesis that ammonia may be the major contributor to overall toxicity of the sewage sludges tested is presented and discussed. (Author's abstract)
W87-01304

APPROACH TO SEWAGE SLUDGE BIOACCUMULATION POTENTIAL TESTS,
Ecological Analysts, Inc., Sparks, MD.
A. F. Maciorowski, W. L. McCulloch, and J. A. Fava.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 253-268. 6 tab, 14 ref.

Descriptors: *Bioaccumulation, *Aquatic animals, *Sludge, *Pesticides, *Heavy metals, *Water pollution effects, Organic compounds, Biological magnification, Ecological effects, Ocean dumping, Sludge disposal, Environmental effects, Clams, Shrimp, Silverside, DDT, Cadmium, Mercury, Polychlorinated biphenyls.

A sewage sludge bioaccumulation potential test responsive to the U.S. Environmental Protection Agency's Ocean Dumping Regulations and Criteria was developed and evaluated with sludges from twelve water pollution control plants with secondary treatment. In keeping with the regulations, the test was designed to examine if hard clams, grass shrimp, and Atlantic silversides exposed to sludge exhibited statistically elevated body burdens of cadmium, mercury, PCB, DDT and metabolites, and petroleum hydrocarbons compared against controls. Exposure consisted of ten-day renewal followed by a two day post-exposure period in clean seawater. Five replicate aquaria per treatment per species were employed using sludge concentrations of 0.033, 0.0084, and 0.0042%. Seven hundred and eighty tissue samples were analyzed for the specified chemicals. Of 195 possible statistical evaluations (13 sludges times 3 species times 5 chemicals), significant differences between treatment group means occurred in only 31 trials. However, in 27 of these trials, the highest body burden mean was at or below pretest levels for the organisms tested, within the concentration range exhibited by control groups over the study period, or present in controls. The inherent limitations of basing pass/fail compliance of ocean-dumped material on a single timepoint exposure are discussed. (Author's abstract)
W87-01305

METHOD OF ASSESSING THE TOXICITY OF CONTAMINATED FRESHWATER SEDIMENTS,
EG and G Bionomics, Wareham, MA. Aquatic Toxicology Lab.
For primary bibliographic entry see Field 5A.
W87-01306

PHOXOCEPHALID AMPHIPOD BIOASSAY FOR MARINE SEDIMENT TOXICITY,
Environmental Research Lab., Narragansett, RI. Ocean Discharge Div.
For primary bibliographic entry see Field 5A.
W87-01307

STATISTICAL TEST PROCEDURE FOR EFFLUENT TOXICITY SCREENING,
SCI Data Systems, Inc., Annapolis, MD.
For primary bibliographic entry see Field 5A.
W87-01308

ISOLATION AND CHEMICAL CHARACTERIZATION OF PETROLEUM REFINERY WASTEWATER FRACTIONS ACUTELY LETHAL TO DAPHNIA MAGNA,
Enwright Labs., Greenville, SC.
For primary bibliographic entry see Field 5A.
W87-01309

BIOLOGICAL IMPLICATIONS OF THE MANAGEMENT OF WASTE MATERIALS: THE IMPORTANCE OF INTEGRATING MEASURES OF EXPOSURE, UPTAKE, AND EFFECTS,
National Ocean Service, Seattle, WA. Ocean Assessments Div.
A. J. Mearns.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 335-343. 1 fig , 17 ref.

Descriptors: *Water pollution effects, *Waste management, *Project planning, *Benefits, *Hazardous materials, Evaluation, Management planning, Bioassay, Accumulation, Waste disposal, Ecological effects, Environmental effects.

A conceptual diagram is presented to help researchers balance and distribute research efforts for the set of waste management issues that revolve around the relations between exposure, uptake, and effects. Since it is unlikely that there will be additional funding for aquatic toxicology research in the near future, efforts receiving priority will be those directed most explicitly towards management issues. Research priorities should be readjusted and monitored daily to attain a more realistic balance among exposure, uptake, and effects. (Geiger-PTT)
W87-01310

OVERVIEW OF BIOLOGICAL EFFECTS TESTING IN PUGET SOUND, WASHINGTON: METHODS, RESULTS, AND IMPLICATIONS,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman, R. N. Dexter, R. M. Kocan, and E. R. Long.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 344-363. 5 fig, 2 tab, 50 ref. NOAA Contract 81 RAC00139.

Descriptors: *Toxicity, *Water pollution effects, *Marine sediments, *Marine animals, *Ecological effects, Industrial wastes, Bioassay, Oligochaetes, Polychaetes, Fish, Amphipods, Mollusks, Environmental effects, Respiration, Washington, Puget Sound.

The toxicity of sediments from 97 sites in the embayments of Puget Sound were tested in acute lethality tests to stickleback fish and two invertebrates (an oligochaete and an amphipod), sublethal tests on the respiration rate of an oligochaete, mitosis tests on fish cells in culture, lethal and sublethal tests on oyster larvae and surf smelt eggs and larvae, lethal and sublethal tests on polychaete life-cycles, and in vitro fish cell reproduction tests. Results indicated that sediments collected from areas shown by other studies to be contaminated with a variety of toxic chemicals were capable of causing lethal and sublethal effects to tested biota in the laboratory. There was good correspondence among the results of different tests. Sediments from badly contaminated areas overall were the most toxic, while those from the least contaminated areas were the least toxic. The data from this and other studies have shown effects at the subcellular, cellular, organ, organism and assemblage levels in parts of Puget Sound. Data on the biological responses are presently being correlated with complimentary chemical data as an initial step to determine possible causes. Data from the present study and previously performed contaminant surveys are being used to prioritize areas in Puget Sound for alternative remedial actions. (Geiger-PTT)
W87-01311

USING THE NATURAL DETOXIFICATION CAPACITIES OF MARINE ORGANISMS TO ASSESS ASSIMILATIVE CAPACITY,
Southern California Coastal Water Research Project Authority, Long Beach.
For primary bibliographic entry see Field 5A.
W87-01312

IMPLICATIONS OF WASTE DISPOSAL IN COASTAL WATERS ON FISH POPULATIONS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
F. A. Cross, D. S. Peters, and W. E. Schaaf.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 383-399. 9 fig, 1 tab, 40 ref.

Descriptors: *Fish populations, *Waste disposal, *Population dynamics, *Water pollution effects, *Models, Coastal zone management, Ocean dumping, Oil spills, Coastal waters, Toxicity, Industrial wastes, Environmental effects, Marine fisheries, Estuarine fisheries, Ecological effects, Stress analysis, Waste management.

Several scenarios of man-made pollution were developed using a density-independent Leslie matrix model and data from the Atlantic menhaden (Brevoortia tyrannus) fishery to stimulate population responses to both catastrophic and chronic mortalities. Adverse impacts to the fishing industry could result from an increase in the ocean dumping of sewage sludge and industrial wastes and oil spilled during the development of offshore oil reserves. In estuaries, adverse impacts could result from a slow but steady decline in water quality associated with human population growth and industrialization of coastal areas. These simulations demonstrated that a fish population which is already heavily fished may have limited compensatory reserve and may be particularly sensitive to pollution. Use of information on commercial fishery populations in impact assessment is recommended because pollution-related effects on marine fishery populations will have direct economic consequences, many major fish stocks that already are overfished should be more vulnerable to additional stresses than nonexploited populations, and long-term data bases that reflect population changes are available. Increased predictive capability of the effects of waste disposal on coastal fish populations can be gained most cost-effectively through closer integration of the disciplines of population dynamics and toxicology. (Author's abstract)
W87-01313

EXTRAPOLATING FROM THE LABORATORY TO THE FIELD: HOW UNCERTAIN ARE YOU,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. W. Suter, L. W. Barnthouse, J. E. Breck, R. N. Gardner, and R. V. O'Neill.

In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 400-413. 8 fig, 20 ref. EPA Office of Research and Development Interagency Agreement 40-740-78, DOE Contract W-7405-eng-26.

Descriptors: *Toxicity, *Models, *Error analysis, *Data interpretation, Probability, Mathematical models, Mathematical studies, Water pollution effects, Fish populations, Ecological effects, Bioassay, Risks, Population dynamics, Model studies, Simulation analysis, Monte Carlo method.

Some of the drawbacks associated with extrapolating laboratory data to field conditions as revealed by the application of risk analysis method to ecological effects of toxic materials are described. A methodology for assessing the toxic effects of chemicals on fish should be able to utilize an emission rate of the pollutant, an LC50, and a description of the receiving system to generate an estimate of the likelihood of reductions in fish populations. This process represents a series of extrapolations, each with an associated variance. The LC50 must be extrapolated from the test species to the species of interest, to life-cycle toxicity, to long-term toxicity in the field, to changes in population size due to direct toxic effects and, finally, to the combined direct and indirect toxic effects. The emission rate must be converted into an effective environmental concentration in an imperfectly understood hydrologic, chemical, physical, and biological system. Some data and methods for making such extrapolations are summarized and sources of uncertainty in each stage of the analysis are described. In general, as more factors are included in toxic assessment models, the total uncertainty in the prediction increases. The level of model complexity chosen for any particular assessment must be determined by comprising conflicting concerns of accuracy, certainty, and finances. (Geiger-PTT)
W87-01314

MODEL FOR PREDICTING THE INFLUENCE OF SUSPENDED SEDIMENTS ON THE BIOAVAILABILITY OF NEUTRAL ORGANIC CHEMICALS IN THE WATER COMPARTMENT,
North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W87-01315

AQUATIC SAFETY ASSESSMENT OF CHEMICALS SORBED TO SEDIMENTS,
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5B.
W87-01316

ROLE OF SEDIMENT ORGANIC MATTER ON SORPTION-DESORPTION REACTIONS AND BIOAVAILABILITY OF MERCURY AND CADMIUM IN AN INTERTIDAL ECOSYSTEM,
Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 5B.
W87-01317

EFFECT OF PHYSICOCHEMICAL FORM ON COPPER AVAILABILITY TO AQUATIC ORGANISMS,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
F. L. Harrison.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 469-484. 1 fig, 10 tab, 42 ref. DOE Contract W-7405-Eng-48.

Descriptors: *Water pollution sources, *Path of pollutants, *Copper, *Bioassay, *Toxicity, *Powerplants, *Water pollution effects, Aquatic animals, Fish, Bluegills, Ecological effects, Heavy metals, Chemical composition, Bioaccumulation, Physicochemical properties, Sediments, Cooling water, Suspended solids.

Copper concentration and speciation were determined in influent and effluent waters collected from eight power stations that used copper alloys in their cooling systems. Quantities of copper associated with particles, colloids, and organic and inorganic ligands differed with the site, season, and mode of operation of the station. Under normal operating conditions, the differences between influent and effluent waters were generally small, and most of the copper was in bound (complexed) species. Copper was high in concentration and present in labile species during start-up of water circulation through some cooling systems and during changeover from an open- to a closed-cycle operation. Copper sensitivity of selected ecologically and economically important aquatic organism was also evaluated. The primary emphasis was on acute effects and most of the testing was performed under controlled laboratory conditions. Sublethal effects of copper on a population of bluegills living in a power station cooling lake containing water of low pH were also assessed. The toxic response to copper differed with the species and life stage of the animal and with the chemical form of copper in the water. (Author's abstract)
W87-01318

BIOAVAILABILITY OF TRACE METALS IN NATURAL WATERS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-01319

BIOLOGICAL DEGRADATION OF COMPLEX IRON CYANIDES IN NATURAL AQUATIC SYSTEMS,
Liesch (Bruce A.) Associates, Inc., Iowa City, IA.
For primary bibliographic entry see Field 5B.
W87-01320

ARE THE 'GUIDELINES FOR DERIVING NUMERICAL NATIONAL WATER QUALITY CRITERIA FOR THE PROTECTION OF AQUATIC LIFE AND ITS USES' BASED ON SOUND JUDGMENTS,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5G.
W87-01321

USE OF STATISTICAL INFORMATION TO IMPROVE COMPATIBILITY BETWEEN THE VARIOUS COMPONENTS OF THE WATER QUALITY BASED APPROACH,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5G.
W87-01326

DYNAMICAL INTERPRETATION OF THE HYDROLOGICAL AND ECOLOGICAL CONDITIONS LEADING TO NOCTILUCA RED TIDE, (INTERPRETATION DYNAMIQUE DES CONDITIONS HYDROLOGIQUES ET ECOLOGIQUES CONDUISANT AUX EAUX ROUGES A NOCTILUCA),
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 5B.
W87-01342

OUTBREAK OF LEGIONNAIRES' DISEASE FROM A COOLING WATER SYSTEM IN A POWER STATION,
Community Health Services, Lancaster (England).
S. Morton, C. L. R. Bartlett, L. F. Bibby, D. N. Hutchinson, and J. V. Dyer.
British Journal of Industrial Medicine, Vol. 43, No. 9, p 630-635, September 1985. 2 fig, 14 ref.

Descriptors: *Legionella, *Cooling water, *Power plants, *Source of pollutants, Human diseases, Epidemiology, Disinfection, Cooling towers.

In September and October 1981 six cases of pneumonia occurred among men working in a power station under construction. Three were identified as cases of legionella pneumonia and two others had serology suggestive of legionella infection. In a sample of 92 men from the site, 10 had low levels of antibodies to legionella. A similar sample of men working on an adjacent site showed none with positive serology. In a case control study it was found that cases of pneumonia were more likely than controls to have worked on a part of the site where four small capacity cooling towers were located. Legionella pneumophila serogroup 1 was isolated from the water systems of these four towers, but was not found in samples from any other cooling towers or hot or cold water outlets on the site. It would appear that there was airborne spread of the organism from these cooling water systems which had not received conventional treatment to inhibit corrosion and organic growth. This is the first outbreak of legionaires' disease to be recorded in an industrial setting in the United Kingdom. No cases of legionella infection have occurred on the site since the introduction of control measures, which included a 24-hour treatment with a biodegradable phenolic thioether (>500 ppm), followed by a detergent based dispersant, and a fresh water flush. Regular treatment of the system was maintained using the phenolic thioether as the principle biocide. (Peters-PTT)
W87-01348

EFFECTS ON FOREST GROWTH OF AIR POLLUTION FROM ENERGY PRODUCTION,
Helsinki Univ. (Finland). Dept. of Silviculture.
P. Hari, T. Raunemaa, and A. Hautojarvi.
Atmospheric Environment ATENBP, Vol. 20, No. 1, p 129-137, January 1986. 10 fig, 24 ref.

Descriptors: *Forest growth, *Air pollution, *Acid rain, Sulfates, Acidification, Finland, Nitrogen, Soil, Fossil fuel, Coniferous forests, Toxicity, Fertilization. Mathematical models.

High concentrations of air pollutants in cities, especially SO2 and heavy metals, have been blamed for forest growth changes. Generalization of the results and a forecast up to the year 2040 is obtained by a model depicting the synthesis of different growth effects. Several field experiments and simulation models have been carried out to support the model approach. SO2 was chosen to represent the effects of direct toxic compounds. SO2 and NOX, in particular, react with water in the atmosphere to produce acid compounds in precipitation. According to the model, considerable changes will occur during 1900-2040. Growth decrease after about the year 1990 is caused by delayed acidification effects in the soil. The model analysis estimates that maximum growth potential in Finland will occur around 1990, followed by an abrupt decrease during the subsequent decade. Changes in the future may be more pronounced than predicted here and deep concern for the future development of the environment is reasonable. (Main-PTT)
W87-01424

COMPARATIVE TOXICITY OF TWO DIMILIN FORMULATIONS TO THE GRASS SHRIMP, PALAEMONETES PUGIO,
Duke Univ., Beaufort, NC. Marine Lab.
J. E. H. Wilson, and J. D. Costlow.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 858-865, June 1986. 1 fig, 3 tab, 13 ref.

Descriptors: *Toxicity, *Water pollution effects, *Pollution effects, *Dimilin, *Palaemonetes pugio, *Shrimp, Diflubenzuron, Pesticides.

The toxicity of diflubenzuron on non-target invertebrates is well documented. An investigation was designed to assess the toxicity of technical grade (TG) and wettable powder (WP-25) diflubenzuron to laboratory-reared larvae of the estuarine shrimp Palaemonetes pugio. Exposure concentrations were 0.1, 0.3, 0.5, 1.0, 2.5, and 5.0 micro g/L active ingredient. There was a total of 50 larvae per test concentration. The survival of Palaemonetes pugio larvae during the first 15 days and to the postlarval stage, was significantly reduced with increasing concentrations of both the TG and the WP-25 formulations of diflubenzuron. The two formulations of diflubenzuron commonly used in laborato-

ry toxicity tests are similar in their efficacy as determined by both acute and chronic toxicity tests with grass shrimp larvae. Within the range of concentrations used in studies, there should be no significant difference in the toxicity of diflubenzuron formulations. (Main-PTT)
W87-01426

ACUTE TOXICITY OF AMMONIA, NITRITE, AND NITRATE TO THE GUADALUPE BASS, MICROPTERUS TRECULI,
Southwest Texas State Univ., San Marcos, Aquatic Station.
J. R. Tomasso, and G. J. Carmichael.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 866-870, June 1986. 15 ref.

Descriptors: *Toxicity, *Water pollution effects, *Nitrites, *Nitrates, *Micropterus treculi, *Lethal contamination, Fish, Nitrogenous waste, Aquaculture.

The acute toxicity of the common nitrogenous wastes found in aquatic environments (ammonia, nitrite, and nitrate) to the Guadalupe bass were determined. Acute toxicity was estimated by determining the 96-h median lethal concentrations (LC50) of Guadalupe bass for the individual nitrogenous metabolites. Concentrations of the metabolites in the experimental aquaria were increased from aquarium to aquarium by a geometric progression factor of 2.0 within each trial. Desired ammonia, nitrite and nitrate concentrations were developed by the addition of ammonium chloride, sodium nitrite and sodium nitrate, respectively. The 96-h LC50 for ammonia nitrogen to Guadalupe bass fingerlings was 12.7 + or - 0.9 mg/L of total ammonia nitrogen. The 96-h LC50 for nitrite-nitrogen to Guadalupe bass was 187.6 + or - 12.1 mg/L. The 96-h LC50 of nitrate nitrogen to Guadalupe bass was 1,261 + or - 142.1 mg/L. Guadalupe bass appear to be slightly less resistant to ammonia than most warmwater species tested. It is more resistant to nitrite than all noncentrarchids tested, and nitrate appears to have no toxic effect at reasonable concentrations. (Main-PTT)
W87-01427

AMMONIUM SULFATE INDUCED NUCLEAR CHANGES IN THE OOCYTE OF THE FISH, CHANNA PUNCTATUS (BL.),
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
R. N. Ram, and A. G. Sathyanesan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 871-875, June 1986. 4 fig, 8 ref.

Descriptors: *Ammonium sulfate, *Water pollution effects, *Channa punctatus, *Nontoxic pollutant effects, *Histological analysis, Fertilizer, Water pollution.

One of the common pollutants present in India's riverine and lacustrine system is the commonly used fertilizer ammonium sulfate. Adult C. punctatus were bought from a local fish market and acclimated to the laboratory conditions. One group was exposed to 100 ppm of (NH4)2SO4 fertilizer for 6 months and the other served as control. This dose was identified as toxicologically safe for (NH4)2SO4 - fish can live normally. In C. punctatus exposed to (NH4)2SO4 for six months, the ovarian growth was inhibited. Due to the absence of mature oocytes the G.S.I. in the treated fish was significantly lowered as compared with control. In experimental C. punctatus the nucleus of the early vitellogenic oocytes degenerated and the ovary was totally devoid of mature oocytes during the spawning phase. (Main-PTT)
W87-01428

EFFECT OF EXTENDED SUBLETHAL EXPOSURE TO SODIUM SELENITE ON CERIODAPHNIA AFFINIS,
Tennessee Dept. of Health and Environment, Nashville. Div. of Environmental Labs.
J. A. Owsley, and D. E. McCauley.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 876-880, June 1986. 2 tab, 17 ref.

Descriptors: *Sodium selenite, *Ceriodaphnia affinis, *Water pollution effects, Toxicity, Fish, Water pollution.

The effect of extended sublethal exposure to sodium selenite on the acute and chronic toxicity of the material to Ceriodaphnia affinis was determined. All toxicity tests were initiated with <24 hour old C. affinis. In acute toxicity tests concentrations of selenite selenium ranged from 0.29 to 3.20 mg/L Se. Test animals with previous exposure to selenite selenium were used in these studies. The chronic toxicity tests exposed 4 consecutive generations of C. affinis to 4 concentrations of selenite selenium ranging from 0.05 to 0.8 mg/L Se. Mortality in the acute toxicity test controls was < or = to 10%. Mortality in the chronic toxicity test was 27% in the first generation, 0% in the second, 7% in the third, and 0% in the fourth. The data presented indicate that C. affinis are less tolerant to selenite selenium after extended exposure to sublethal levels of the material. (Main-PTT)
W87-01429

CHANGES IN ACID PHOSPHATASE ACTIVITY IN TISSUES OF CRAB, OZIOTELPHUSA SENEX SENEX, FOLLOWING EXPOSURE TO METHYL PARATHION,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
P. S. Reddy, A. Bhagyalakshmi, and R. Ramamurthi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 106-112, July 1986. 2 tab, 18 ref.

Descriptors: *Acid phosphatase, *Water pollution effects, *Parathion, *Tissue analysis, *Oziotelphusa senex, *Crabs, *Methyl parathion, Pesticides, Toxins.

The effect of exposure to Methyl parathion on acid phosphatase activity in the tissues of crab (Oziotelphusa senex) is reported. Specimens of the crab were collected from rice fields and irrigation canals. Prior to use they were acclimated to laboratory conditions for one week. The crabs were exposed to 0.1, 0.2, 0.5, and 1.0 mg per L of methyl parathion. Ten crabs from each container were killed at 1, 3, 5, 10, 15, and 30 days. The hepatopancreas and muscle tissues were homogenised and centrifuged. The clear supernatant was used for enzyme assay. Acid phosphatase activity was significantly higher than the control levels in both the tissues in all four experimental groups on day 1. Elevation was found to increase gradually in both the tissues on further exposure leading to maximum on day 3 in the 0.1 ppm group and on day 5 in 0.1-0.5 and 1.0 ppm groups. There was a gradual decrease in elevation on further exposure. The elevation in acid phosphatase activity in the present study could be attributed to pesticide induced changes in lysosomal activity. (Main-PPT)
W87-01432

ACCLIMATION TO SUBLETHAL ACIDIC AND ALKALINE MEDIA OF TILAPIA MOSSAMBICA (PETERS): CHANGES IN GLYCOGEN METABOLISM OF RED MUSCLE,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W87-01433

TOXICITY OF DIBUTYL PHTHALATE-CONTAMINATED SEDIMENT TO LABORATORY- AND FIELD-COLONIZED ESTUARINE BENTHIC COMMUNITIES,
Environmental Research Lab., Gulf Breeze, FL.
M. E. Tagatz, G. R. Plaia, and C. H. Deans.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 1, p 141-150, July 1986. 2 fig, 2 tab, 12 ref.

Descriptors: *Toxicity, *Water pollution effects, *Dibutyl phthalate, *Plasticizer, *Sediments, *Benthic communities, Alkyl esters, PVC resins, Epoxy.

Effects of dibutyl phthalate (DBP) on macrobenthic animals that colonized sand-filled boxes for 8 weeks in the laboratory and in the field were determined by comparing community structures in boxes that contained uncontaminated and DBP-contaminated sand. Laboratory boxes were colonized by settling of planktonic larvae entrained in seawater from Santa Rosa Sound, whereas field boxes located in 3 m of water in Santa Rosa Sound were colonized by naturally occurring animals. The boxes were filled with clean sand (control) or sand mixed with varying amounts of DBP. Sediment oxidation-reduction potential (Eh) was determined and communities were harvested in laboratory and field boxes. The Kruskal-Wallis distribution free procedure was used to test for phthalate-exposure effects on organisms. DBP concentrations were determined by gas chromatography. Seven-day loss of DBP from sediments ranged from 43 to 69% in the laboratory and from 40 to 80% in the field. Thirty to 53 micro g DBP/L leached into water from contaminated sediments on the second day; none was detected after 7 days. Eh profiles in laboratory and field boxes revealed the highest DBP contamination resulted in anaerobic conditions and a more chemically reducing environment than did lower or no contamination. The average number of species in the high exposure group was significantly less than the average in the control group. As in the laboratory, field community structure was significantly affected by the highest concentration of DBP in sediment. (Main-PTT)
W87-01436

ALKALIZATION OF A HIGH-ELEVATION SIERRA NEVADA STREAM,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 4C.
W87-01447

ENZYMATIC HYDROLYSIS OF PROTEINACEOUS PARTICULATE AND DISSOLVED MATERIAL IN AN EUTROPHIC LAKE,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
For primary bibliographic entry see Field 5B.
W87-01456

UREA METABOLISM AND ITS SIGNIFICANCE IN THE NITROGEN CYCLE IN THE EUPHOTIC LAYER OF LAKE BIWA: I. IN SITU MEASUREMENT OF NITROGEN ASSIMILATION AND UREA DECOMPOSITION,
Osaka Kyoiku Univ. (Japan). Lab. of Environmental Science and Education.
For primary bibliographic entry see Field 2H.
W87-01457

LIGHT CLIMATE OF A SMALL DEEP LAKE (PIBURGER SEE, AUSTRIA) AND ITS INFLUENCE ON PHYTOPLANKTON PRODUCTION,
Innsbruck Univ. (Austria). Botanisches Inst.
For primary bibliographic entry see Field 2H.
W87-01459

CHANGES OF TRIHALOMETHANE FORMATION POTENTIALS IN THE TONE RIVER,
Gunma Inst. of Public Health (Japan).
For primary bibliographic entry see Field 5B.
W87-01468

MINERALIZATION OF ORGANIC MATTER AND OTHER CHEMICAL EFFECTS OF CHLORINATION,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W87-01473

EFFECT OF ADDED RADIOCARBON SOLUTION ON PRIMARY PRODUCTION MEASUREMENTS,
Helsinki Univ., Lammi (Finland). Lammi Biologi-

ical Station.
K. Salonen, and L. Arvola.
Water Research WATRAG, Vol. 20, No. 8, p 1041-1044, August 1986. 3 fig, 2 tab, 12 ref.

Descriptors: *Carbon radioisotopes, *Primary productivity, *Water pollution effects, Phytoplankton, Inhibition, Ions, Heavy metals.

The effect of inorganic radiocarbon stock solution on the measurements of primary productivity of phytoplankton was studied in lake waters with low ionic strength and high concentration of dissolved organic matter. The results of this study together with those published in the literature show that the addition of inorganic radiocarbon solution can inhibit primary production of phytoplankton. The inhibition may vary according to environment and may be most pronounced in waters with low ionic strength. In latter cases the reason is not necessarily only contamination by heavy metals. The major ions used for the preparation of radiocarbon solution may also have some effect on primary productivity of phytoplankton. Problems resulting from the radiocarbon solutions can be largely eliminated by using additions of radiocarbon less than 0.1% of sample volume. The existence of possible stimulation of primary productivity of phytoplankton with proportionally small quantities of radiocarbon solution requires more investigation. (Lantz-PTT)
W87-01474

GROWTH CHARACTERISTICS OF AEROMONAS HYDROPHILA IN LIMNETIC WATERS OF VARYING TROPHIC STATE,
Rhode Island Univ., Kingston. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-01482

BACTERIAL GLUCOSE UPTAKE IN THE WATER BODY OF THE EDER RESERVOIR (WEST GERMANY)(ZUR BAKTERIELLEN GLUCOSEAUFNAHME IM WASSERKOERPER DER EDERTALSPERRE),
Frankfurt Univ. (Germany, F.R.). Fachbereich Biologie.
For primary bibliographic entry see Field 2H.
W87-01483

OBSERVATIONS ON LAKES NEAR MOUNT ST. HELENS: PHYTOPLANKTON,
Goldsmiths' Coll., London (England). Dept. of Biological Sciences.
M. A. Smith, and M. J. White.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 345-362, July 1985. 32 fig, 2 tab, 22 ref.

Descriptors: *Limnology, *Mount St. Helens, *Phytoplankton, *Water pollution effects, *Spirit Lake, *Meta Lake, *McBride Lake, *Volcanoes, Washington, Chemical analysis, Algal blooms, Cations, Growth dynamics.

Surface water samples were collected during August, 1982, from lakes in the vicinity of Mount St. Helens, Washington (Spirit Lake, Meta Lake, and McBride Lake), and examined for chemical and phytoplankton composition. Major cation concentrations differed in the lakes due to their relative positions to blast trajectories, ashfalls, mudflows, and pyroclastic flows. Both diatom and chrysophyte blooms were observed but other phytoplankton species, not likely to be preserved in the lake sediments, were recorded in significantly high numbers. The phytoplankton data is of particular interest for comparison with assemblages preserved in sediments formed under similar volcanic conditions. (Author's abstract)
W87-01485

DYNAMICS OF CHLOROPHYLL AND PHOTOSYNTHESIS IN NATURAL PHYTOPLANKTON ASSOCIATIONS: II. PRIMARY PRODUCTIVITY, QUANTUM YIELDS AND PHOTOSYNTHETIC RATES IN SMALL NORTHGERMAN LAKES,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
M. -E. Meffert, and J. Overbeck.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 363-385, July 1985. 11 fig, 6 tab, 53 ref.

Descriptors: *Chlorophyll, *Limnology, *Photosynthesis, *Phytoplankton, *Growth dynamics, Primary productivity, Germany, Lakes, Trophic level, Mesotrophic lakes, Eutrophic lakes, Algal growth.

Photosynthetic characteristics of phytoplankton assemblages were investigated in situ at weekly intervals throughout the year in both the Plusee and the Edebergsee, from 1981 to 1984. Findings of the previous 20 years in the Plusee are confirmed. Primary productivity is estimated at about 500 mg/sq m/d for the entire year, corresponding, as do chlorophyll concentration and extinction coefficient, to data given for mesotrophic or moderately eutrophic lakes. The differing primary production of the two lakes is compared in relation to their morphometry. Maximum quantum yields are constant in the light-limited range, varying between 0.01-0.08 moles C/Einstein absorbed, depending largely on the stage of algal growth. Three different algal assemblages had values of about 0.06 moles C/Einstein absorbed when measured during growth stages. The chlorophyll specific light attentuation (k sub c) for five algal populations ranged between 0.007 - 0.02 sq m/mg chlorophyll-a. Other photosynthetic characteristics varied as follows: the initial slope of the light-saturating curve, alpha (B), lay between 0.0025-0.015 mg C/(mg chl-a)/mE/sq m; the onset of light saturation, I sub k, between 49-320 microE/sq m/s; the maximum photosynthetic capacity, P sub max, between 1-4 mg C/(mg chl-a)/h. The controlling action of global radiation is demonstrated by season and latitudinal dependant shifts of both the light-proportional photosynthesis and P sub max. Data of P sub max suggest that values are often below 5 mg C or 15 mg O2/(mg chl-a)/h in meso- and eutrophic waters between the 50th-74th latitude north, in contrast to similar waters at lower latitudes. (Author's abstract)
W87-01486

FACTORS CONTROLLING PHYTOPLANKTON POPULATION IN A BOG, MATSUMIKE, JAPAN,
Tokyo Univ. of Fisheries (Japan).
For primary bibliographic entry see Field 2H.
W87-01487

SELECTIVE INHABITATION OF PARASITIC CYANOPHYTE PSEUDANABAENA IN WATER-BLOOM MICROCYSTIS COLONIES,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
T. -P. Chang.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 3, p 419-426, September 1985. 4 fig, 4 tab, 20 ref.

Descriptors: *Blooms, *Microcystis, *Limnology, *Cyanophyta, *Pseudanabaena, *Population dynamics, Growth, Carbon radioisotopes, Dissolved organic carbon, Algal toxins, Toxins.

C-14 prelabeled exudates and cell-extracts of Microcystis aeruginosa were used for a heterotrophic uptake by Pseudanabaena. Such an assimilation is influenced by toxins present in these DOC-14. The uptake of toxin-containing DOC-14 is very low, and can cause the mobile Pseudanabaena to change its epiphytica habitation. An accumulation of Pseudanabaena around Microcystis cells could indicate a nontoxic matrix of the host algae. Because of its mobility, Pseudanabaena can leave toxic Microcystis and search a nontoxic site for epiphytic growth. A thick and firm matrix of nontoxic M. wesenbergii should be a barrier; in the colonial lobes, some trichomes of Pseudanabaena seem to wait for this nutrition. In other nontoxic colonies, Pseudanabaena is somewhat distanced from host cells by the Microcystis mucilage. The enclosed Pseudanabaena can achieve only a minimal growth on DOC-exudates, because its photosynthesis is inhibited by a light and CO2 deficiency due to cell shields and mucilage enclosure. In some decaying colonies, Microcystis cells autolyzed and produced probably first the toxin which could stop the endophytic heterotrophy. Pseudanabaena should enter into a resting stage, where the ensheathed trichomes, which look like Phormidium, can protect themselves and their intercellular lumen against the Microcystis toxin. With this toxin, Microcystis can be avoided by animal grazings, and both algae can together overwinter on the lake bottom. Consequently, Pseudanabaena filaments could be carried by Microcystis, or other water bloom species, into the next water bloom period to be distributed further and, therefore, may settle down in many environmental niches. (Lantz-PTT)
W87-01489

NATIONAL ACADEMY OF SCIENCES REPORT. ACID DEPOSITION: TRENDS, RELATIONSHIPS, AND EFFECTS,
Pennsylvania Univ., Philadelphia.
A. H. Johnson.
Environment ENVTAR, Vol. 28, No. 4, p 6-11, 34-39, May 1986. 6 fig, 10 ref.

Descriptors: *Water pollution effects, *Air pollution effects, *Acid deposition, *Acid rain, Pollution, Water pollution, Air pollution, Acid precursors, Surface water acidity.

Acid deposition has grown into a major environmental issue for Canada and the United States. The causes of acid deposition are well known. Fossil fuel combustion is responsible for more than 90 percent of the sulfur and nitrogen oxides emitted to the atmosphere. The effects of acid deposition have been studied and debated since the mid-1960s when Europeans began to ask whether the deterioration of water quality in Scandinavian lakes was related to atmospheric acids. As a step towards consensus on a sufficient number of issues to formulate policy, the Committee on Monitoring and Assessment of Trends in Acid Deposition was formed under the auspices of the Environmental Studies Board of the U.S. National Research Council. A broad range of views were discussed. The factors under discussion were a postulated relationship to acid deposition, availibility of published data, and availibility of data representative of broad geographical regions. By studying trends in a variety of phenomena thought to be related to acid deposition, some interesting patterns were discovered. The findings of the committee are in agreement with the larger range of available data that suggest acid deposition has adverse effects on visibility, surface-water quality and fish populations. (Khumbatta-PTT)
W87-01504

INTEGRATED APPROACH TO ASSESSING ACID DEPOSITION,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
R. E. Munn.
Environment ENVTAR, Vol. 28, No. 4, p 12-13, May 1986. 2 ref.

Descriptors: *Acid deposition, *Water pollution effects, *Air pollution effects, *Acid rain, U.S. National Academy of Sciences, Pollution, Water pollution, Environmental protection.

Public debates about stratospheric ozone depletion, atmospheric greenhouse warming, acid deposition, and other environmental trends have become noisy with political overtones. Acid deposition first became an issue when the Scandinavian rivers were noticably affected in the 1960s. By the late 1970s acid rain was front page news and the scientific community in North America was scrambling. The U.S. National Academy of Sciences were to assess the state of knowledge about temporal and spatial trends in acid deposition in North America. The report made a valuable contribution to our knowledge of acid deposition trends in North America. The report is not the final word on acid deposition trends. This will lead to an improvement in current sampling strategies for monitoring acid deposition, making it possible to follow the biogeochemical disruption in an integrated fashion from sources to receptors. (Khumbatta-PTT)
W87-01505

PATTERNS OF POLLUTION IN THE HUDSON-RARITAN BASIN,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Engineering and Public Policy.
For primary bibliographic entry see Field 5B.
W87-01506

EFFECT OF FENITROTHION ON REPRODUCTION OF THE FRESHWATER PRAWN MACROBRACHIUM LAMERRII,
Marathwada Univ., Aurangabad (India). Dept. of Zoology.
R. Sarojini, R. Nagabhushanam, and S. A. Mary.
Ecotoxicology and Environmental Safety EESADV, Vol. 11, No. 3, p 243-250, June 1986. 9 fig, 7 ref.

Descriptors: *Water pollution effects, *Fenitrothion, *Prawns, *Freshwater prawns, Shrimp, Pesticides, Toxicity, Pesticide toxicity, Toxic level, Pollution.

Studies concerning the effects of pesticides on reproduction are of recent interest. Eggs and larvae of crustacea are the life history stages which are most sensitive to environmental stress. The widespread use of pesticides to control agricultural pests poses a critical threat to freshwater prawns. At sublethal levels, toxicants can severely impair the physiological functions of organisms, which in turn will terminate the productivity. The present investigation was undertaken to study the toxic levels of fenitrothion (organophosphate) to eggs and larvae of the freshwater prawn. Macrobrachium lamerrii were exposed to acute and chronic toxicity. Histopathological changes in gonads are also examined. The hatching success of the eggs is not affected when berried females are exposed to fenitrothion. No drastic changes in egg production are seen at sublethal levels, while at higher concentrations females abort their eggs. The first stage larvae hatching in subacute chronic exposure are not morphologically abnormal. The rate of heart pulsation in embryos and larvae increased under pollutant stress. Larvae are highly susceptible and death rate of larvae does not increase during molt period. On chronic exposure there are drastic changes in the gonads of Macrobrachium Lamerrii. (Khumbatta-PTT)
W87-01507

INCLUSION BODIES: FORMATION AND DEGENERATION OF THE OOCYTES IN THE FISH CHANNA PUNCTATUS (BLOCH) IN RESPONSE TO AMMONIUM SULFATE TREATMENT,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
R. N. Ram, and A. G. Sathyanesan.
Ecotoxicology and Environmental Safety EESADV, Vol. 11, No. 3, p 272-276, June 1986. 7 fig, 17 ref.

Descriptors: *Water pollution effects, *Fertilizers, *Inclusion bodies, *Oocytes, *Fish, *Ammonium sulphate treatment, Pollution, Toxicity, Un-ionized ammonia.

Ammonium sulfate ((NH4)2SO4) is one of the commonly used and easily degradable fertilizers often washed into riverine and lacustrine systems as a pollutant. In water, (NH4)2SO4 is ionized and it is the un-ionized ammonia (UIA) base which causes toxic effects as the ionized form cannot pass tissue barriers. Ammonia is a ubiquitous pollutant of water resources and is known to cause alterations in several biochemical and physiological processes of fishes. Prolonged exposure of Clarias batrachus to ((NH4)2SO4) causes impairment of interrenal and thyroid function. However, very little is known about its effect on the reproduction of fishes. In this study occurrence of ((NH4)2SO4) induced extra- and intranuclear inclusion bodies is reported in the stage-I oocyte of Channa punctatus. Adult Channa punctatus were exposed to 500 ppm of the commonly used fertilizer ammonium sulfate for 6 months from January to June, as a result of which the ovarian growth was retarded significantly. The inhibition of the ovarian growth was reflected on the gonadosomatic index which was significantly reduced as compared with control. (Khumbatta-PTT)
W87-01509

IN VIVO MODIFICATION OF FATTY ACIDS AND GLYCERIDES METABOLISM IN RESPONSE TO 1,2,3,4,5,6-HEXACHLOROCYCLOHEXANE AND CYTHION EXPOSURE IN THE CATFISH, CLARIAS BATRACHUS,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
B. Lal, and T. P. Singh.
Ecotoxicology and Environmental Safety EESADV, Vol. 11, No. 3, p 295-307, June 1986. 4 fig, 3 tab, 39 ref. DST Grant in aid HCS/DST/928/80; ICAR Grant FG-IN-620, PL-480 project IN-ARS-213.

Descriptors: *Water pollution effects, *Fatty acids, *Glycerides, *Catfish, *Cythion, *Hexachlorocyclohexane, Acyl glycerides, Pesticides, Reproductive cycle, Toxicity, Pollution.

Hazards of environmental contamination through indiscriminate use of a variety of pesticides have attracted global attention. Pesticides, even in very low concentrations, have been reported to interfere with basal metabolism. Intoxication deranges intermediary metabolism primary to ATP production resulting in depletion of energy sources. Specimens of either sex of the freshwater catfish, Clarias batrachus, were exposed to safe and sublethal concentrations of gamma-BHC (2 and 8 ppm) and cythion (1 and 4 ppm) for 4 weeks during different phases of annual reproductive cycle. Their effects on free fatty acids (FFA) and acyl glycerides, viz., mono-glycerides (MG), diglycerides (DG), and triglycerides (TG), were studied in liver, plasma, gonads, and muscle. During the preparatory phase, both pesticides suppressed the levels of FFA and acylglycerides (MG, DG and TG) in liver of either sex but had no effect on their levels in plasma, ovary, and muscle; however, FFA and TG were reduced in testis. In the prespawning phase different lipids responded variedly to the concentrations of both Cythion and gamma-BHC. In the female, FFA in liver and plasma was raised but in ovary and muscle it was decreased. Acylglycerides in studied tissues were also reduced except ovarian TG which was increased by both pesticides at safe concentrations. In the male these lipids were raised in liver and testis. During the spawning phase, these pesticides enhanced the hepatic FFA together with acylglycerides in the female but failed to elicit any change in their levels in the male. Plasma levels of FFA and TG were reduced in the female; however, in the male FFA was raised and TG remained unchanged. Ovarian FFA and TG were decreased and increases, respectively. During the postspawning phase, none of the lipid fractions could be affected in the male except hepatic FFA which was reduced; however, in the female TG along with FFA was decreased. (Khumbatta-PTT)
W87-01510

RELATIVE TOXICITY OF TECHNICAL MATERIAL AND COMMERCIAL FORMULATION OF MALATHION AND ENDOSULFAN TO A FRESHWATER FISH, CHANNA PUNCTATUS (BLOCH),
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. Haider, and R. M. Inbaraj.
Ecotoxicology and Environmental Safety EESADV, Vol. 11, No. 3, p 347-351, June 1986. 1 tab, 2 fig, 10 ref.

Descriptors: *Water pollution effects, *Pesticides, *Bioassay, *Toxicity, *Malathion, *Endosulfan, *Freshwater fish, *Bloch, Fish, Trimmed Spearman-Karber method.

In India the acute toxicity of a wide spectrum of organophosphorus and organochlorine compounds were studied in a large number of fishes. The acute toxicity of commercial formulation of malathion and the relative toxicity of alpha and beta isomers, techincal material, and commercial formulation of endosulfan have been studied in Channa punctatus. In the present aquatic bioassay the relative toxicity of the technical material and a commercial formulation of malathion (as organophosphorus insecticide) and endosulfan (an organochlorine insecticide) in Channa punctatus was investigated. Relative toxicity of technical and commercial formulations of malathion and endosulfan were evaluated by determining LC50 values and their 95% confidence interval end points for 24, 48, 72 and 96 hr exposure to Channa punctatus using the trimmed Spearman-Karber method. The commercial formulations of malathion and endosulfan were 1.176 and 1.88 times more toxic than their technical materials, respectively. Ninety-six hour LC50 values (0% trimming) of technical and commercial formulations of malathion and endosulfan (95% confidence interval in parentheses) were 4.51 (4.11-4.96) and 3.89 (3.46-4.38) mg/liter, and 5.78 (4.49-7.44) and 3.07 (2.43-3.84) microgram/liter, respectively. Fishes showed characteristic changes in behaviour when exposed to various concentrations of these insecticides. (Khumbatta-PTT)
W87-01511

EFFECT OF A MERCURIAL FUNGICIDE ON THE GONADAL DEVELOPMENT OF THE TELEOSTEAN FISH CHANNA PUNCTATUS (BLOCH),
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
R. N. Ram, and A. G. Sathyanesan.
Ecotoxicology and Environmental Safety EESADV, Vol. 11, No. 3, p 352-360, June 1986. 8 fig, 49 ref.

Descriptors: *Water pollution effects, *Gonadal development, *Teleosts, *Mercurial fungicide, *Fungicides, *Fish, Pesticides, Water pollution, Toxicity, Emisan.

Mercury constitutes an important water pollutant because of its high toxicity, non-biodegradability and persistent nature, and its tendency to undergo food chain biomagnification. In India, about 180 tons of mercury is introduced into the environment every year, of which 166 tons are from the caustic soda manufacturing industries. Organic alkyl, alkoxyalkyl, aryl, and inorganic mercurial fungicides have been extensively used for seed dressing, as turf fungicides, and in orchards. Mercury compounds entering in the aquatic system are increasing and some large carnivorous fishes are known to accumulate the highest concentratious of methyl mercury (MeHg). Neurotoxic, teratologic, and genetic effects of methyl mercury have been extensively studied in mammals. However, very little is known about its effects on the endocrine physiology including reproduction. Channa punctatus was exposed to a safe concentration of 0.20 ppm of a commercial mercurial fungicide, Emisan (MeEHgCl), for 6 months, from January to June, exhibited significant inhibition of gonadal development as evidenced by their histology and reduced gonadosomatic index. Degenerative changes were also evident. Correlative histological changes were also noted in the pituitary gonadotrophs which were reduced in the exposed fish. Several stage-I oocytes exhibited proteinaceous extra and intranuclear inclusion bodies, and intranuclear ring-like bodies associated with the ultimate degeneration of the oocytes. These observations suggest that MeEHgCl inhibits gonadal development through the hypothalamic-pituitary-gonadal axis in these species. (Khumbatta-PTT)
W87-01512

INCREASED MICROSPORIDIAN PARASITISM OF THE CRAYFISH ORCONECTES VIRILIS IN AN EXPERIMENTALLY ACIDIFIED LAKE,
Department of Fisheries and Forestry, Winnipeg (Manitoba).
For primary bibliographic entry see Field 2H.
W87-01564

EFFECTS OF PARAQUAT AND GLYPHOSATE ON GROWTH, RESPIRATION, AND ENZYME ACTIVITY OF AQUATIC BACTERIA,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
K. Chan, and S. C. Leung.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No 52-59, January

1986. 4 fig, 1 tab, 19 ref.

Descriptors: *Paraquat, *Glyphosate, *Growth, *Respiration, *Enzymes, *Aquatic bacteria, *Water pollution effects, Bacteria, Herbicides, Pesticides, Bacterial physiology, Aeromonas, Pseudomonas, Population density.

The effects of the herbicides paraquat and glyphosate were studied on growth, respiration, and enzyme activity of aquatic bacteria. The number of colony forming units (CFU) was found to decrease on addition of paraquat to experimental pools. CFU counts decreased from 200,000/ml to 100/ml in 10 days. The response to glyphosate was similar but less severe. Bacteria that survived herbicide treatment were able to grow rapidly again after herbicide residues were removed by water current. The addition of a solution containing phenylalanine and tyrosine can eliminate the inhibitory action of glyphosate on bacterial growth. Respiration of Aeromonas hydrophila was only slightly inhibited by the two herbicides. The herbicides significantly inhibited oxygen uptake by Pseudomonas chlororaphis. Dehydrogenase activity was not severely affected by the herbicides. Results indicate that aquatic bacteria are more susceptible to paraquat than are the soil microflora and human bacteria. (Doria-PTT)
W87-01574

OBSERVATIONS OF BLUEGILLS FED SELENIUM-CONTAMINATED HEXAGENIA NYMPHS COLLECTED FROM BELEWS LAKE, NORTH CAROLINA,
Duke Power Co., Huntersville, NC. Environmental Services Section.
K. A. Finley.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 6, p 816-825, December 1985. 3 fig, 1 tab, 10 ref.

Descriptors: *Bluegills, *Selenium, *Contamination, *Hexagenia, *Belews Lake, North Carolina, *Toxicity, Water pollution effects, Fish, Mayflies, Insects, Aquatic insects, Path of pollutants, Benthic environment, Electric powerplants, Coal ash, Fish food organisms.

Belews Lake, North Carolina was impounded in the 1970s to provide cooling water for a coal-fired electric generating station. Subsequent large-scale reproductive failure in fish has been attributed to elevated selenium levels originating from a coal ash settling pond. This study attempts to document the occurrence of selenium toxicity in bluegills fed to satiation a diet consisting of mayfly nymphs (Hexagenia limbata), a common benthic food organism found in the lake. Symptoms previously documented in field studies, including exophthalmia, edema, and abdominal distention, were observed in laboratory-fed fish after 13 to 20 days of feeding. Additional observations consistent with selenium toxicity included food avoidance and loss of equilibrium. Selenium concentrations in both liver and skeletal muscle were correlated with the degree of dietary exposure. The primary focus of pathology was on tissues associated with detoxification (liver) and elimination (kidney, gills, and blood). These effects were observed in lieu of any other significant source of selenium. Findings support the contention that a benthic dietary pathway contributes significantly to the present failure of the Belews Lake fishery. (Doria-PTT)
W87-01575

MODIFICATION OF AN ESTUARY,
Geological Survey, Menlo Park, CA.
F. H. Nichols, J. E. Cloern, S. N. Luoma, and D. H. Peterson.
Science SCIEAS, Vol. 231, No. 4738, p 567-573, February 7, 1986. 10 fig, 54 ref.

Descriptors: *Estuaries, *San Francisco Bay, *Ecological effects, *Environmental effects, *Urbanization, *Water quality, Habitats, Dikes, Wastes, Aquatic environment, Sediments, Aquatic life, Impaired water quality.

Human activity has rapidly modified the San Francisco Bay estuary. Diking and filling of most of its wetlands have eliminated habitats for fish and waterfowl; the introduction of exotic species has transformed the composition of its aquatic communities; reduction of freshwater inflow by more than half has changed the dynamics of its plant and animal communities; and wastes have contaminated its sediments and organisms. Continued disposal of toxic wastes, the probable further reduction in freshwater inflow, and the possible synergy between the two provide the potential for further alteration of the estuary's water quality and biotic communities. (Doria-PTT)
W87-01578

INFLUENCE OF CERTAIN TYPES OF WASTE WATER UPON THE ROTIFERAL BIOCENOSIS IN ACTIVATED SLUDGE,
Ljubljana Univ. (Yugoslavia). Inst. of Chemistry.
M. Toman, and M. Rejic.
Zeitschrift fuer Wasser- und Abwasserforschung ZWABAQ, Vol. 18, No. 4, p 16 August 1985. 7 fig, 9 tab, 7 ref.

Descriptors: *Wastewater treatment, *Rotifers, *Activated sludge, Toxicity, Bulking sludge, Bioindicators, Chemical oxygen demand, Biological oxygen demand, Temperature, Hydrogen ion concentration, Temperature, Sludge volume index, Animal wastes, Dissolved oxygen.

The influence of certain types of wastewater on the organisms of concomitant biocenosis, especially rotifers, was studied in a laboratory treatment plant. The operation of the biological treatment plant was monitored by such parameters as chemical oxygen demand (COD), biological oxygen demand (BOD), pH, temperature, dissolved oxygen, concentration of volume, and sludge volume index. No direct relation was established between the difference in COD or BOD of the influent and effluent and the numbers of rotifers. However, rotifers show changes in activated sludge as changes in their habitat, which sooner or later can be observed in the treatment effect. Piggery waste in certain concentrations decreases the number of rotifers in activated sludge, which, however, does not seem to influence the final treatment effect. It is concluded that rotifers are convenient for a rapid appraisal of the state of activated sludge because they are an important part of the concomitant biocenosis and relatively easy to analyze in terms of the quantitative biological investigation. (Doria-PTT)
W87-01583

PHYTOPLANKTON PRIMARY PRODUCTION, STANDING CROP AND SPECIES SUCCESSION IN THE TONGUE RIVER RESERVOIR, MONTANA,
Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2H.
W87-01600

HEAVY METALS IN LAKE KINNERET (ISRAEL): I. TOTAL COPPER AND CUPRIC ION CONCENTRATIONS IN LAKE KINNERET AND THE RIVER JORDAN,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-01602

ALTERATION OF IRON-CACO3 PRECIPITATION BY YELLOW ORGANIC ACIDS OF AQUATIC ANGIOSPERM ORIGIN,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W87-01609

GAMMARIDS IN STREAMS OF NORTHEASTERN BAVARIA, F.R.G.: II. THE DIFFERENT HYDROCHEMICAL HABITATS OF GAMMARUS FOSSARUM KOCH, 1835 AND GAMMARUS ROESELI GERVAIS, 1835,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2H.
W87-01611

ECOPHYSIOLOGICAL STUDIES ON ACID TOLERANCE OF GAMMARUS FOSSARUM (OKOPHYSIOLOGISCHE UNTERSUCHUNGEN ZUR SAURETOLERANZ VON GAMMARUS FOSSARUM (KOCH),
Gesamthochschule Kassel (Germany, F.R.). Inst. fuer Zoologie.
V. W. Meinel, U. Matthias, and S. Zimmermann.
Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 2, p 287-302, August 1985. 9 fig, 4 tab, 18 ref.

Descriptors: *Ecosystems, *Acid rain, *Water pollution effects, *Tolerance, *Gammarus, *Acidic water, Gammarus fossarum, Hydrogen ion concentration, Potassium, Magnesium, Calcium, Sulfates, Sodium.

The acidification of running waters results in a reduction of the species composition. Gammarus fossarum shows a very high sensitivity against low environmental pH and becomes damaged below pH 6 in low buffered waters. In some experiments, G. fossarum was kept in acid waters (pH 4.5, 4.0, 3.5, 3.0) with different ionic composition. It was found out that the survival rate at pH 4.5 and 4.0 could be enhanced by increasing the sodium concentration. Other cations (K(+), Mg(2+), Ca(2+)) had no significant influence. The positive effect of sodium was related to the presence of chloride. With other anions (SO4(2-), the efficiency of sodium for the survival rate is smaller. Below pH 4.0, the addition of sodium did not increase the survival time. The toxicity of environmental pH to 4.0 is caused by a failure of ionic regulation, especially by a breakdown of the sodium and chloride uptake. In waters with higher H(+) concentrations, other mechanisms, like acid/base balance and gas exchange, could be damaged. (Author's abstract)
W87-01612

EFFECT OF SUSPENDED SOLIDS ON THE GROWTH OF APICAL TIPS OF GAMETOPHYTE PLANTS OF LEMANEA AND ON CARPOSPORE GERMINATION AND SUBSEQUENT COLONISATION,
University Coll., Cardiff (Wales). Dept. of Plant Science.
H. H. Thirb, and K. Benson-Evans.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p409-417, June 1985. 3 tab, 18 ref.

Descriptors: *Suspended solids, *Plant growth, *Lemanea, *Aquatic plants, *Usk River, *Wales, Germination, Coal, Photosynthesis, Primary productivity, Light intensity.

The physical characteristics of coal particles are objectionable in streams, since they interfere with self-purification by diminishing photosynthesis and by smothering benthic organisms. In this study, it was decided that in order to gain the most information on the influence of suspended solids, it was necessary to assess the tolerance of the thallus of the plant, and the efficiency of the methods of colonization, in various concentrations of suspended solids. Under conditions where there are high concentrations of suspended solids in suspension and as settled material covering the river bed, the ability to reproduce (from carpospores) and to recolonize what may be an unstable substrate becomes of major importance. Field surveys from sampling stations throughout the River Usk and other South Wales rivers were carried out at monthly intervals at each station and indicated that, although Lemanea has a widespread distribution, it is generally found in clean streams, and only rarely occurs below sources of man-made pollution. It seems, therefore, that although suspended solids were restricting the growth of Lemanea they were not preventing it entirely. Reduction in light intensity from turbid conditions of suspended solids (5,000 mg/L) was found experimentally to reduce primary production in both the chantransia-stage and adult plants. In the field the deposition of a thick layer of silt prevented fixation and colonization of the substrate by carpospores. (Lantz-PTT)

W87-01613

INTER- AND INTRA-HABITAT DISTRIBUTION OF LEECHES IN A EUTROPHIC ENGLISH LAKE.
Liverpool Univ. (England). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-01614

RESPONSES OF PHYTOPLANKTON IN LAKE JACARETINGA TO ENRICHMENT WITH NITROGEN AND PHOSPHORUS IN CONCENTRATIONS SIMILAR TO THOSE OF THE RIVER SOLIMOES (AMAZON, BRAZIL),
Universidade Estadual Paulista, Botucatu (Brazil). Inst. Basico de Biologia Medica e Agricola.
R. Henry, K. Hino, J. G. Tundisi, and J. S. B. Ribeiro.
Archiv fuer Hydrobiologie AHYBAY, Vol. 103, No. 4, p 453-477, June 1985. 14 fig, 4 tab, 40 ref. NSF Grant BSR-800.3203.

Descriptors: *Phytoplankton, *Lake Jacaretinga, *Nitrogen, *Phosphorus, *Solimoes River, *Brazil, *Amazon, Water pollution effects, Biomass, Chlorophyll, Photosynthesis, Productivity, Limnology, Tropical regions.

An 'in situ' enrichment experiment was conducted in Lake Jacaretinga (Amazon) in January 1982 to assess the possible nutrients (nitrate or phosphate) that stimulate the phytoplankton growth. The results showed a significant increase of biomass (chlorophyll-a) and of photosynthetic activity after only two days incubation. This increase was due to nitrate addition in the water samples. On day four, a decrease of chlorophyll and primary productivity occurred. This reduction was explained as a function of predation by zooplankton. On day six of incubation, an increase of productivity was observed, and was due probably to ammonia excretion by zooplankton and decomposition action by bacteria. A discussion of the mechanisms of fertility of Lake Jacaretinga during the year is presented. The nitrogen action as a limiting factor to phytoplankton in tropical lakes is also discussed. (Author's abstract)
W87-01615

MODELING THE EFFECTS OF ACID DEPOSITION: CONTROL OF LONG-TERM SULFATE DYNAMICS BY SOIL SULFATE ADSORPTION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. J. Cosby, G. M. Hornberger, R. F. Wright, and J. N. Galloway.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1283-1291, August 1986. 6 fig, 1 tab, 32 ref. NSF Grant No. CEE-8215914.

Descriptors: *Model studies, *Water pollution effects, *Acid rain, *Sulfates, *Soil contamination, Adsorption, Air pollution, Simulation analysis, Drainage water, Catchments.

A dynamic model based on a simple nonlinear relationship between adsorbed and dissolved sulfate in soils is used to examine the implied long-term control exerted on drainage water sulfate concentration by mineral soil adsorption. The model assumes reversible adsorption and does not consider biological sulfur transformations or variable adsorption arising from changes in soil organic matter or pH. The model is used to simulate the effects of more than a century of increased atmospheric sulfur deposition into low-order, mountainous catchments. The response time of simulated drainage water sulfate concentration is a function of the hydrological retention time and the amount of sulfate adsorbed on the soil. Simulated catchments with small adsorption capacity respond at essentially the hydrological response time (months to a year). Simulated catchments with large adsorption capacity respond much more slowly (decades). These response times decrease dramatically as adsorbed sulfate accumulates. There has been a tendency to classify catchments as those that respond to changes in sulfur deposition and those that do not. Our results suggest that (at least for low-order, shallow soil catchments) responses to sulfur deposition are continuous, not dichotomous, and response times will decrease under prolonged atmospheric deposition. (Author's abstract)
W87-01630

MODELING THE EFFECTS OF ACID DEPOSITION: UNCERTAINTY AND SPATIAL VARIABILITY IN ESTIMATION OF LONG-TERM SULFATE DYNAMICS IN A REGION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
G. M. Hornberger, B. J. Cosby, and J. N. Galloway.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1293-1302, August 1986. 6 fig, 4 tab, 28 ref. NSF Grant CEE-8215914.

Descriptors: *Acid rain, *Water pollution effects, *Spatial distribution, *Sulfates, *Mathematical models, Model studies, Environmental effects, Chemical analysis, Shenandoah National Park, Virginia, Streams.

The choice of appropriate parameter values for mathematical models that are meant to describe long-term (decades or longer) changes in hydrochemical catchment responses to atmospheric deposition, is difficult because long time series of observations are generally unavailable. Some information about the range (or distribution) of stream chemistry variables across a given region is often available, however, and this can provide useful guidance in selecting allowable values for parameters for regional application of this model. A method is given for using data that describe the present-day distribution of stream water chemistry in a region, to constrain allowable ranges of parameters in a mathematical model, and to infer particular parameter combinations that are inconsistent with observations. The method is applied to a simple model of catchment sulfate dynamics using measured sulfate concentrations from several streams in Shenandoah National Park, Virginia. Acceptable parameter combinations for this case are well defined by a single linear axis. Extrapolation of the distribution of sulfate concentrations into the future using these acceptable parameter combinations suggests that a shift in mean sulfate concentration in the southwest section of the park would be detectable with 90% certainty 8 to 10 years hence, assuming that atmospheric deposition remains constant. (Author's abstract)
W87-01631

BIOLOGICAL MONITORING OF MARINE POLLUTANTS.
National Oceanic and Atmospheric Administration, Washington, DC.
Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. Edited by F. John Vernberg, Anthony Calabresse, Frederick P. Thurberg, and Winona B. Vernberg. 559 p.

Descriptors: *Marine environment, *Water pollution, *Biological monitoring, Water pollution effects, Monitoring, Ecological effects, Environmental effects, Heavy metals, Hydrocarbons, Oil pollution, Physiological ecology, Information exchange, Marine biology.

Considerable laboratory research has been performed on the physiological effects of pollutants on marine organisms, with a more recent trend toward applying laboratory techniques to field studies. The objective of this volume is to show how these techniques may be used in field-oriented biological monitoring programs, a small number of which are now underway in various parts of the world. The combination of laboratory studies with field studies should give us a better understanding of the effects of pollutants on marine life. Topics highlighted are: (1) synthetic organics, (2) heavy metals, (3) petroleum hydrocarbons, and (4) physiological monitoring. (See also W87-01718 thru W87-01738) (Lantz-PTT)
W87-01717

OVERVIEW OF THE ACUTE AND CHRONIC EFFECTS OF FIRST AND SECOND GENERATION PESTICIDES ON AN ESTUARINE MYSID,
Environmental Research Lab., Gulf Breeze, FL.
D. R. Nimmo, T. L. Hamaker, E. Matthews, and J. C. Moore.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 3-19, 7 tab, 21 ref.

Descriptors: *Pesticides, *Estuaries, *Toxicity, *Environmental effects, *Water pollution effects, Shrimp, Crustaceans, Lethal limit, Bioindicators, Growth, Chemical analysis.

Results of laboratory experiments conducted at the Environmental Research Laboratory for several years indicate that the mysid shrimp, Mysidopsis bahia, can be used as a practical test species for life-cycle studies to determine the sublethal effects of toxicants. Ratios of the acute 96-hour lethal concentrations to the maximum acceptable toxicant concentration (MATC) ranged from 0.01 to 0.54, indicating that, in some instances, acute tests can be predictive of chronic effects. Criteria used to establish MATC limits were: (1) effects on growth, (2) reduced reproduction, (3) chronic toxicity and, (4) with two chemicals reproduction and chronic toxicity concurrently. Though the data base is incomplete, the acute tests with M. bahia and eleven pesticides, show sensitivities within a factor of 10 to some decapod crustaceans--most of them being penaeid shrimp. Acute studies conducted elsewhere show M. bahia to be as sensitive to, or in many instances, more sensitive than five fresh water and marine species commonly used in toxicity testing. (See also W87-01717) (Lantz-PTT)
W87-01718

EFFECTS OF TWO ORGANOPHOSPHATE PESTICIDES ON SWIMMING STAMINA OF THE MYSID MYSIDOPSIS BAHIA,
Environmental Research Lab., Gulf Breeze, FL.
G. M. Cripe, D. R. Nimmo, and T. L. Hamaker.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 21-36, 3 fig, 2 tab, 34 ref.

Descriptors: *Organophosphates, *Pesticides, *Shrimp, *Physiological ecology, *Water pollution effects, Toxicity, Methyl parathion, Phorate, Insecticides, Analysis of variance, Chemical analysis, Biological pesticides, Bioassay.

The purpose of this study was to test the ability of Mysidopsis bahia to maintain its position in a current, and to determine the feasibility of a behavioral bioassay based on short-term toxicant exposure and rheotactic response in a stamina tunnel. This was accomplished by (1) observing the maximum sustained speed (MSS) of various age groups of mysids throughout a life cycle, (2) comparing the performance of laboratory reared M. bahia at specific ages with young of feral M. bahia, and (3) comparing the MSS of laboratory reared control M. bahia with that of mysids that had been exposed for 96 hr to different concentrations of the organophosphate insecticides, methyl parathion or phorate. Following completion of the study, no significant difference in MSS (analysis of variance, $p > 0.05$) was indicated when pooled measurements of laboratory stock were compared to polled measurements of feral mysides. The MSS measurements of laboratory reared mysids were recorded after a 96-hr exposure to the organophosphate insecticides, methyl parathion or phorate. The results indicated a threshold of effect concentration for reduction of swimming stamina between 0.31 and 0.56 micrograms methyl parathion/L, and between 0.078 and 0.18 micrograms phorate/L. The effect and no-effect concentrations found from the MSS measurements after 96-hr exposure were very similar to those obtained in a 28-day life-cycle test that exposed mysids to the same compounds. This suggests a potential for use of the MSS measurement

as a rapid-screening bioassay. (See also W87-01717) (Lantz-PTT)
W87-01719

COMPARATIVE TOXICOLOGY AND PHARMACOLOGY OF CHLOROPHENOLS: STUDIES ON THE GRASS SHRIMP, PALAEMONETES PUGIO,
University of West Florida, Pensacola. Dept. of Biology.
K. R. Rao, F. R. Fox, P. J. Conklin, and A. C. Cantelmo.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 37-72, 10 fig, 2 tab, 53 ref. EPA Grant No. R-804541.

Descriptors: *Water pollution effects, *Toxicity, *Chlorophenols, *Grass shrimp, Chemical analysis, Cyclic variation, Growth, Sodium pentachlorophenol, Molting, Dichlorophenol, Radioactive tracers, Trichlorophenol, Pentachlorophenol, Tetrachlorophenol, Ionization, Regeneration, Quantitative analysis, Qualitative analysis, Seawater.

Experiments were designed to determine whether the grass shrimp would exhibit a cyclic variation in susceptibility to various chlorophenols in relation to the molt cycle. The grass shrimp is most susceptible to sodium pentachlorophenate at the time of molting. Because sodium pentachlorophenate inhibits regenerative limb growth in grass shrimp, additional experiments were conducted to determine whether other chlorophenols would exert similar effects. Studies on the acute toxicity of 2,4-dichlorophenol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4,6-tetrachlorophenol, 2,3,5,6-tetrachlorophenol, and pentachlorophenol to grass shrimp at known stages of the molt cycle revealed that, with the exception of 2,4-dichlorophenol, the various chlorophenols were more toxic to molting shrimp than to nonmolting and intermolt shrimp. 2,4-Dichlorophenol was, however, equally toxic to molting and nonmolting shrimp. Radiotracer studies with 14-C-2,4,5-trichlorophenol and 14-C-pentachlorophenol indicated that the higher toxicity of these chlorophenols to molting shrimp is due to an increased bioaccumulation of these compounds during the period shortly after molting. In general, the toxicity of chlorophenols could not be correlated to either the number of Cl-atoms in these compounds, or to the pK sub a (ionization constants). When exposed to media containing pentachlorophenol or 2,4,5-trichlorophenol grass shrimp bioaccumulated these chlorophenols very rapidly. When such chlorophenol-loaded shrimp were transferred to clean seawater, most of the accumulated chlorophenol was lost from the shrimp within 12 to 24 hours. Qualitative and quantitative analysis of the metabolites of 14-C-pentachlorophenol in the grass shrimp indicated that methylation (anisole formation), glucuronide conjugation, and dechlorination are among the pathways of pentachlorophenol disposition in this shrimp. (See also W87-01717) (Lantz-PTT)
W87-01720

BIOCHEMICAL STRESS RESPONSES OF MULLET MUGIL CEPHALUS AND POLYCHAETE WORMS NEANTHES VIRENS TO PENTACHLOROPHENOL,
Texas A and M Univ., College Station. Dept. of Biology.
P. Thomas, R. S. Carr, and J. M. Neff.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 73-103, 4 fig, 3 tab, 87 ref. NSF Grant No. OCE 77-24551.

Descriptors: *Water pollution effects, *Toxicity, *Bioaccumulation, *Mullet, *Polychaetes, *Pentachlorophenol, Biochemical tests, Lethal limits, Toxicity, Ascorbic acid, Hypoglycemia, Hyperglycemia, Cholesterol.

This paper describes the effects of pentachlorophenol (PCP) exposure on several biochemical parameters in juvenile mullet, Mugil cephalus and the sandworm Neanthes virens (=Nereis virens Sars). Coelomic fluid osmolality and glucose concentrations and tissue ascorbic acid levels were monitored in N. virens during acute lethal and chronic sublethal exposure to PCP. The effects of acute exposure to lethal levels of PCP on plasma cortisol concentrations and several secondary stress responses in M. cephalus were examined. Aspects of carbohydrate, lipid and electrolyte metabolism were investigated in order to determine which homeostatic mechanisms fail during exposure to lethal levels of the toxicant. PCP concentrations which were acutely lethal to N. virens (above 365 micrograms/L) caused marked coelomic fluid hypoglycemia and ascorbic acid depletion from parapodial tissue within 48 hours. Different biochemical responses were observed when worms were exposed to sublethal levels (120 micrograms/L PCP). Coelomic fluid glucose rose to approximately two times the control level by 24-hr, and subsequently declined to control levels by 96-hr and decreased thereafter. The concentration of tissue free ascorbic acid rose steadily during exposure to the lower concentrations of PCP, suggesting synthesis or mobilization of bound ascorbate reserves in response to sublethal stress. PCP was considerably more toxic to mullet. Mortality reached 33% after 48-hr exposure to 100 micrograms/L PCP, and after 24-hr exposure to 200 micrograms/L PCP. Plasma cortisol concentrations did not rise until the second day of exposure to the lower dose, whereas a rapid elevation of cortisol occurred in mullet exposed to 200 micrograms/L PCP. The rise in cortisol concentrations was accompanied by a marked hyperglycemia and a depletion of hepatic glycogen reserves, whereas hepatic ascorbic acid concentration and serum osmolality rose more slowly. Changes in ascorbic acid concentrations were evident after 24-hr exposure to either dose, while serum osmolality was unaltered after 48-hr exposure to 100 micrograms/L PCP. Total plasma cholesterol levels were not affected by either dose of PCP. (See also W87-01717) (Lantz-PTT)
W87-01721

EFFECTS OF SILVER ON RESPIRATION AND ON ION AND WATER BALANCE IN NEANTHES VIRENS,
Bridgeport Univ., CT. Dept. of Biology.
J. J. Pereira, and K. Kanungo.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 107-125, 6 fig, 2 tab, 22 ref.

Descriptors: *Silver, *Water pollution effects, *Toxicity, *Neanthes virens, *Hydrologic balance, *Respiration, Sodium, Potassium, Calcium, Worms, Maine, Long Island Sound, Milford, Connecticut, Marine sediments, Physiological effects, Lethal limits.

Neanthes virens was used to study the effects of exposure to silver on respiration, on the concentration of Na(+), K(+), and Ca(2+) in the coelomic fluid, and on the water balance of the worms. These parameters were correlated with the levels of silver accumulated by the worms. Animals were obtained from two geographical locations: from Maine where the levels of silver in the environment are presumed lower, and from Long Island Sound near Milford, Connecticut where silver has been demonstrated to exist in the sediments. Worms from Maine accumulated levels of silver as high as 209 ppm (dry weight), whereas Long Island Sound worms accumulated levels only as high as 90 ppm. In 'Maine' worms, exposure to silver resulted in a decrease in the rate of oxygen consumption only after worms had accumulated 113 ppm silver. The oxygen consumption rates of exposed 'local' animals were not significantly different from that of the controls, but were significantly higher than 'Maine' worms which were similarly exposed. In 'Maine' worms, exposure to silver produced an increase in K(+) concentrations, and a decrease in Ca(+) concentrations in coelomic fluid after a body burden of 88 ppm silver was reached. The concentration of Na(+) did not show any significant change. 'Local' worms showed no change in Na(+) or K(+) concentrations, but showed a decrease in Ca(+) concentration in their coelomic fluid. Water content of exposed 'Maine' worms showed a decrease, while 'local' worms did not exhibit any such losses. Exposure to silver also resulted in localized edema in the parapodia and in curled posture in both the 'Maine' and the 'local' worms, although the 'local'-worms were affected to a lesser degree than the 'Maine' worms. It is postulated that the 'local' worms, as a result of their chronic exposure to sublethal concentrations of silver in their natural environment, developed a tolerance to silver. This tolerance could account for the low level of silver in the body and the relatively smaller alteration of their physiological state as compared to that of the 'Maine' animals. (See also W87-01717) (Lantz-PTT)
W87-01722

FACTORS AFFECTING TRACE METAL UPTAKE AND TOXICITY TO ESTUARINE ORGANISMS: I. ENVIRONMENTAL PARAMETERS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
D. W. Engel, W. G. Sunda, and B. A. Fowler.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 127-144, 8 fig, 27 ref.

Descriptors: *Water pollution effects, *Trace metals, *Toxicity, *Estuarine environment, *Bioaccumulation, Environmental effects, Marine animals, Bioavailability, Copper, Cadmium, Silver, Chemical analysis, Biological analysis.

Trace metals can exist in a variety of different chemical forms in natural waters including free ions, inorganic complexes, organic complexes, and metal adsorbed on or incorporated into, particulate matter. The chemical forms of a metal in aqueous media depend on both the chemical properties of the individual metal and the chemical composition of the natural water. This paper deals only with water as a pathway for trace metal bioavailability, and therefore, with processes initiated by the passage of a trace metal across external membranes. Trace metal reactions can occur in both directions and all components of the system are interrelated. Therefore, any shift in one portion of the system will affect other components as well. The ionic metal concentration (Me(n+)) (or more correctly its activity or chemical potential) is an extremely important variable in determining trace metal-biota interactions, but this variable itself is determined by the chemical poise of the entire system. Examined is the aquatic chemistry of copper, cadmium, and silver with emphasis on organic and inorganic complexation in estuarine seawater. The chemical speciation of dissolved copper, cadmium and silver affect the biological responses of organisms exposed to these metals and from these data, several conclusions can be drawn: (1) The aquatic chemistries of the three metals are complex; broad generalizations among metals concerning their chemistries and biological effects cannot be made. (2) The toxicity and biological accumulation of copper and cadmium appear to be determined primarily by free ion concentration (or activity), while with silver, chlorocomplexes may also play an important chemical role in the accumulation of this metal by marine organisms. Thus, although the free model is found to be valid in many, if not most instances, it does not appear to hold true in all cases. (3) The toxicity and bioaccumulation of trace metals are manifestations of chemical processes occurring both in the water and in the organism, indicating that chemical speciation of the metal must be considered when conducting these studies. (See also W87-01717) (Lantz-PTT)
W87-01723

FACTORS AFFECTING TRACE METAL UPTAKE AND TOXICITY TO ESTUARINE ORGANISMS: II. CELLULAR MECHANISMS,
National Inst. of Environmental Health Sciences, Research Triangle Park, NC. Lab. of Organ Function and Toxicology.

B. A. Fowler, N. G. Carmichael, K. S. Squibb, and D. W. Engel.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 145-163, 7 fig, 46 ref.

Descriptors: *Water pollution effects, *Trace metals, *Bioaccumulation, *Toxicity, *Estuarine environment, Environmental effects, Shellfish, Food chains, Bioavailability, Lysosomes, Chemical analysis, Biochemical analysis, Iron, Mercury, Lead, Copper, Zinc, Marine animals, Tissue analysis, Calcium, Phosphorus, Oysters.

Many marine organisms consumed as food by man are known to concentrate potentially toxic trace metals from the environment but data on the basic biological processes involved in this phenomenon are relatively limited. Such data are of extreme importance both with respect to understanding how marine shellfish survive in metal-polluted areas and assessing the role of these organisms as vectors for human exposure to metals. Combined ultrastructural, analytical and biochemical laboratory studies, have identified lysosomes, low molecular weight metal-binding proteins and concretions as major intracellular compartments responsible for trace metal accumulation in several species of marine shellfish. Lysosomes play a role in the intracellular compartmentation of iron, mercury, lead, copper and zinc in marine invertebrates. Low molecular weight proteins (6-10,000 MW) bind cadmium, copper, manganese and zinc in various organs of commercially important marine species under both laboratory and field exposure conditions. Intracellular calcium-phosphorus concretions in kidneys of marine bivalves and the hepatopancreas of crustaceans have also been shown to be primarily responsible for the high levels of several potentially toxic trace metals found in these organs. In oysters, accumulation of cadmium by gills can be altered by concomitant exposure of oysters to cadmium and selenium, although total cadmium accumulation by this marine species is not changed by the elemental interaction. This suggests that mechanisms of metal uptake and storage differ within different organ systems. A major point to be derived from these studies is that marine species appear to possess a variety of mechanisms for metabolizing and accumulating toxic metals from the environment. (See also W87-01717) (Lantz-PTT)
W87-01724

EFFECTS OF COPPER AND CADMIUM ON THE BEHAVIOR AND DEVELOPMENT OF BARNACLE LARVAE,

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W. H. Lang, D. C. Miller, P. J. Ritacco, and M. Marcy.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 165-203, 7 fig, 10 tab, 75 ref.

Descriptors: *Water pollution effects, *Copper, *Cadmium, *Barnacles, *Larvae, Estuarine environment, Stress analysis, Mortality, Growth rates, Photoactivation, Swimming, Salinity, Lethal limits, Toxicity, Molting.

Early sublethal indicators of stress were studied using invertebrate larval stages. Nauplii of the common estuarine barnacle Balanus improvisus were exposed for 48 to 96 hrs to copper and cadmium. Five stress indices were monitored at 24-hr intervals: mortality, rate of development, normality of molting, spontaneous swimming speeds, and photobehavior. Of particular interest is the evaluation of behavioral responses as stress indices. The use of a newly developed video-computer analysis system now allows a relatively rapid and accurate assessment of multiple movement parameters. Exposure levels of Cu ranged from 10-160 ppb, which is below the 96-hr LC50. Molting to Stage III was progressively delayed with increasing Cu concentration. Loss of setae and deformation of appendages occurred in nearly all stage III nauplii, including the lowest concentration tested (10 ppb). Spontaneous swimming speed initially increased from 20 to 80 ppb Cu, but by 72 hrs was significantly depressed at all exposure levels. Photokinesis and phototaxis also changed, but only at concentrations above threshold for changes in spontaneous swimming speeds. Phototactic behavior was also altered by salinity, and a further interaction with Cu occurred. Exposure levels of Cd ranged from 50-200 ppb. At 30 ppt, mortality for 96-hr remained below 50% at all concentrations, while at 15 ppt, a 96-hr LC50 occurred between 100 to 200 ppb Cd. At 100 ppb Cd, development was delayed, and no molting abnormalities were noted. At 24 hrs, spontaneous swimming speeds were increased at 50 to 100 ppb Cd at 30 ppt, but depressed at 100 ppb Cd at 15 ppt. After 24-hrs swimming speeds were consistently depressed at 100 ppb Cd, while at 50 ppb Cd a mixed response was observed. Unlike results with Cu, Cd tended to enhance positive phototaxis. Embryo-larval life stages of marine organisms typically proved to be most sensitive to pollutants. (See also W87-01717) (Lantz-PTT)
W87-01725

ONTOGENY OF RESISTANCE ADAPTATION AND METABOLIC COMPENSATION TO SALINITY AND TEMPERATURE BY THE CARIDEAN SHRIMP, PALAEMONETES PUGIO, AND MODIFICATION BY SUBLETHAL ZINC EXPOSURE,

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C. L. McKenney Jr., and J. M. Neff.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 205-240, 8 fig, 6 tab, 65 ref. NSF Grant No. ID075-04890.

Descriptors: *Ontogeny, *Adaptation, *Salinity, *Temperature, *Shrimp, *Zinc, *Sublethal effects, *Water pollution effects, Survival, Larvae, Growth, Metabolism.

The ontogeny of possible resistance and metabolic capacity adaptations to salinity and temperature were studied through the complete larval development of the caridean shrimp, Palaemonetes pugio. Any disruptions in these responses by sublethal zinc exposure were examined. Changing patterns in survival and metabolic rates were measured during the complete larval development of P. pugio, reared from hatch through metamorphosis in 9 combinations of salinity (7-31 ppt) and temperature (20-30 C), both with and without exposure to a sublethal zinc concentration (0.25 ppm Zn). While early larval stages were extremely tolerant of a broad range of salinities and temperatures, late larval stages, beginning with the second to the last larval stage, were more sensitive to temperature. Furthermore, as larval development progresses, the last two larval stages demonstrate reduced resistance to high salinities. These changing salinity-temperature survival patterns during the ontogeny of P. pugio, were modified by continuous sublethal zinc exposure with alterations being stage dependent with the first and last larval stages being most sensitive to zinc. The most pronounced influence of sublethal zinc exposure on metabolic rates of developing larvae was a depression of the respiratory rates of the first stage, second from the last and the last larval stage under conditions of moderate to high temperatures in high salinities and in low salinity-temperature conditions. These alterations in metabolic capacity are in agreement with reduced resistance adaptations of P. pugio larvae reared under continuous exposure to a sublethal zinc concentration. Since adaptive capacities and the mechanism involved are evolutionary products, it appears that changing ontogenetic adaptive capacities of P. pugio reflect phylogenetic migration from life in marine waters to life in freshwater. (See also W87-01717) (Lantz-PTT)
W87-01726

EFFECTS OF SALINITY AND MERCURY ON DEVELOPING MEGALOPAE AND EARLY CRAB STAGES OF THE BLUE CRAB, CALLINECTES SAPIDUS RATHBUN,

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IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 241-262, 2 fig, 2 tab, 63 ref. EPA Grant No. R801305.

Descriptors: *Water pollution effects, *Salinity, *Mercury, *Crabs, Lethal limits, Sublethal effects, Metamorphosis, Growth, Megalopae, Larvae, Growth rates, Regression analysis, Survival.

The effect of a broad range of salinities and several mercury concentrations on the megalopa and early crab stages of the blue crab, Callinectes sapidus were studied, considering both lethal and sublethal effects, including any alterations in survival and abnormalities in rate of development within each juvenile stage. Megalopae of C. sapidus, reared from hatch through zoeal development at 25 C and 30 ppt salinity, were maintained through completion of metamorphosis and through the first two crab stages at 16 combinations of salinity (10-40 ppt) and mercury (0-20 ppb) to determine the individual and combined influences of these factors on both survival and rate of development. Individual, but not interactive, effects of salinity and mercury significantly affected viability of developing megalopae. Survival of megalopae was highest at a salinity of 30 ppt. Concentrations of mercury, which proved sublethal for megalopae developing at optimal salinity conditions, reduced the salinity range for successful completion of metamorphosis of C. sapidus. As the salinity was lowered, less mercury was required to produce equal mortality among megalopae. Developmental rates of C. sapidus megalopae were significantly influenced by salinity and mercury. Response-surface analysis estimated a minimum developmental duration of 8 days to exist between salinities of 22 and 29 ppt for megalopae. Following the completion of metamorphosis, C. sapidus was more resistant to altered salinity conditions and to mercury toxicity. The reduced viability, restricted euryplasticity, and retarded developmental rates of C. sapidus megalopae developing at low ppb concentrations of mercury, may reduce recruitment into parent estuarine populations and alter distributional patterns of developing C. sapidus larvae. (See also W87-01717) (Lantz-PTT)
W87-01727

APPLICATION OF BIOCHEMICAL AND PHYSIOLOGICAL RESPONSES TO WATER QUALITY MONITORING,

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IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 265-294, 3 fig, 3 tab, 92 ref.

Descriptors: *Water pollution effects, *Biochemical tests, *Physiological response, *Water quality control, *Monitoring, Bioindicators, Environmental effects, Stress, Acclimitization, Adaptation, Water quality management, Toxicity, Sublethal effects, Ecological effects.

Biochemical and physiological responses can provide an early warning of reductions in water quality, typically because of their short response times to natural environmental changes. Environmental physiology response models are applicable to the development of pollutant indices, for there are many parallels between physiological responses to natural change, and pollutant stress. However, interpretation of the significance of alterations in biochemical and physiological responses to pollutants may not always be straightforward, since these responses are subject to modification by a number of environmental and endogenous factors. The capacity of organisms for biochemical and physiological compensation to environmental change, for example, may markedly modify a stress response over time. A number of reports of biochemical and physiological change following pol-

lutant stress are cited here. The utility of some of these responses for biomonitoring is largely conjectural, however, since very few studies have been conducted in field organisms. A research approach is discussed to: (1) apply biochemical and physiological responses to long-term stress, (2) document the influence of biotic and abiotic variables on these responses, (3) identify the cause and effect relationships and effective dose thresholds, (4) determine the potential of biomonitoring species to detoxify, store and excrete pollutants, and (5) evaluate the ecological consequences of observed pollutant effects. (See also W87-01717) (Lantz-PTT)
W87-01728

EFFECTS OF CHRONIC LOW CONCENTRATIONS OF NO. 2 FUEL OIL ON THE PHYSIOLOGY OF A TEMPERATE ESTUARINE ZOOPLANKTON COMMUNITY IN THE MERL MICROCOSMS,
Maryland Univ., Solomons. Chesapeake Biological Lab.
S. L. Vargo.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 295-322, 11 fig, 42 ref. EPA Grant No. R803902020.

Descriptors: *Water pollution effects, *Oil pollution, *Physiological ecology, *Zooplankton, *Estuaries, Ecological effects, Ecosystems, Oil-water interfaces, Respiration, Toxicity, Acartia tonsa, Acartia clausi, Population dynamics, Excretion.

Chronic low levels of an oil-water dispersion (OWD) of No. 2 fuel oil affect the respiration and excretion rates of zooplankton in the MERL microcosms. An average concentration of 180 ppb caused irreversible changes in the respiration and excretion rates of chronically exposed animals, while an average concentration of 90 ppb did not. Respiration and excretion rates of the zooplankton community were stimulated by oil concentrations between 98-133 ppb, but decreased at higher concentrations. The O:N ratio for the community decreased at lower oil concentrations and increased at higher concentrations, indicating a switch from proteins to carbohydrates and lipids as metabolic substrates. The physiological responses of numerically dominant species in the community, in one case were the same as that of the community (Acartia tonsa), and in the other not (A. clausi). Physiological changes shown by the community and its species lead to changes in total abundance and species composition, but the time scale of these structural changes was much longer than that for the functional changes. Therefore, monitoring of physiological changes gives an earlier indication of the effect of oil on the community. (See also W87-01717) (Lantz-PTT)
W87-01729

EFFECTS OF CRUDE OIL ON GROWTH AND MIXED FUNCTION OXYGENASE ACTIVITY IN POLYCHAETES, NEREIS SP.,
Skidaway Inst. of Oceanography, Savannah, GA.
R. F. Lee, J. Stolzenbach, S. Singer, and K. R. Tenore.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 323-334, 1 fig, 31 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Physiological effects, *Polychaetes, Coastal waters, Worms, Georgia, Food chains, Benz(a)anthracene, Hydrocarbons, Nereis succinea.

Changes in mixed function oxygenase (MFO) were monitored activity in the polychaetes, Nereis succinea and N. virens, after exposure to crude oil or certain aromatic hydrocarbons. The effects of oil on growth rates of N. succinea were studied in coastal Georgia, and biomasses per individual of a population of N. virens were compared in oil contaminated and clean sites in coastal Maine. Exposure to crude oil, in the polychaete N. succinea from coastal Georgia, resulted in a decrease in growth rate and an increase in mixed function oxygenase (MFO) activity relative to unexposed controls. At a food concentration of 156 mg nitrogen/sq m/day, the growth rate of worms fed oil-contaminated food and control worms, were 1.91 + 0.22 and 2.73 + 0.30 mg/day, respectively. The authors speculate that oil affected the feeding rate of N. succinea. N. virens, from an oil-polluted area of Maine, had a lower weight and slightly higher MFO activity than worms from a 'clean' site. An increase of MFO and cytochrome P-450, a component of the MFO system, was found in intestinal homogenates from N. virens fed food contaminated with benz(a)anthracene, a polycyclic aromatic hydrocarbons. (See also W87-01717) (Lantz-PTT)
W87-01730

COMPARISON OF SEVERAL PHYSIOLOGICAL MONITORING TECHNIQUES AS APPLIED TO THE BLUE MUSSEL, MYTILUS EDULIS, ALONG A GRADIENT OF POLLUTANT STRESS IN NARRAGANSETT BAY, RHODE ISLAND,
Environmental Research Lab., Narragansett, RI.
D. K. Phelps, W. Galloway, F. P. Thurberg, E. Gould, and M. A. Dawson.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 335-355, 7 fig, 4 tab, 19 ref.

Descriptors: *Physiological effects, *Monitoring, *Water pollution effects, Mussels, Stress analysis, Narragansett Bay, Rhode Island, Marine environment, Nickel, Crabs, Tissue analysis, Nitrogen, Oxygen, Metabolism, Growth, Gills, Respiration.

Sublethal pollutant stress in mussels was clearly detected in a field-monitoring situation using these criteria of physiological response: scope for growth, tissue residue analysis, and gill respiration and glycolytic rates in either gill or posterior adductor muscle. Scope for growth and gill-tissue oxygen consumption are both valuable indices of metabolic stress in mussels. Scope for growth is the more comprehensive, labor-intensive index. It has the advantage of relating an index of condition directly to such vital whole-body functions as growth and reproduction. Gill respiration is a simpler, faster measure that can be used with larger numbers of animals in a short period of time with limited laboratory space available. It does not, however, provide direct information on feeding rates or nitrogen metabolism. Examination of enzyme activity in mussel gill and posterior adductor muscle confirmed the results of gill-tissue oxygen consumption and the scope for growth. Hemolymph ion and adenylate energy charge measurements did not detect pollutant stress in mussels held at the polluted field station of this study. The relative abundance of pinnotherid crab commensals proved to be an interesting potential indicator of relative pollution in the field. Analysis of animal tissues for specific toxicants has been demonstrated to be a reliable indicator of relative degree of pollution in the field. Levels of nickel in Mytilus tissues for each of the four stations studied, were remarkably stable over a three-year period, and both nickel and petroleum hydrocarbons reflected the stress gradient in Narragansett Bay. This study presents the necessary coupling of tissue residue analyses to assess biological effects. (See also W87-01717) (Lantz-PTT)
W87-01731

EFFECTS OF MUNICIPAL WASTEWATER ON FERTILIZATION, SURVIVAL, AND DEVELOPMENT OF THE SEA URCHIN, STRONGYLOCENTROTUS PURPURATUS,
Southern California Coastal Water Research Project Authority, Long Beach.
P. S. Oshida, T. K. Goochey, and A. J. Mearns.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 389-402, 4 tab, 20 ref. University of Southern California Marine and Freshwater Biomedical Center, USPH Grant No. 1 P30 ESO 1965-015RC.

Descriptors: *Municipal wastewater, *Water pollution effects, *Survival, *Fertilization, *Urchins, Toxicity, Larvae, Embryonic growth stage, Digested sludge, Effluents, Santa Monica Bay, California, Bioassays. Seawater.

Nearly one billion gallons (3.70 billion liters) of municipal wastewater are discharged daily into coastal waters of the Southern California Bight. Most of the wastewaters are unchlorinated and are injected into the ocean through deep ocean outfalls (60 m depth, several km offshore) fitted with multiport diffusers which initially dilute the wastewaters by factors of 80 to 200. An important purpose of this dilution is to mitigate possible toxicity to marine life in the water column. However, marine organisms have rarely been used to assess the toxicities of these effluents. Instead, freshwater fish have been, and still are being used as 96-hour bioassay organisms for the determination of wastewater toxicity. Because of this reliance on freshwater fish, it is uncertain whether or not water quality near the discharges is suitable for survival and growth of sensitive stages of marine organisms. This paper examines the subject of wastewater toxicity by studying the effects of municipal wastewater and digested sludge on fertilization, survival, and development of purple sea urchin gametes, embryos, and larvae. These early life stages are both sensitive to marine pollutants and critical for normal growth of the urchins. It was found that municipal wastewaters reduced fertilization of urchin eggs at concentrations generally higher than 1-7% effluent. Using a 100 to 1 seawater to effluent ratio as a hypothetical 'minimum initial dilution' of effluents and sludge injected into the ocean, two of three effluents tested did not affect fertilization outside the zone of initial dilution. Digested sludge, as discharged into the Santa Monica Bay, California, was very toxic within and near the zone of initial dilution. The urchin fertilization test was 5-10 times more sensitive than the 96-hour freshwater fish bioassay now being used by the dischargers. (See also W87-01717) (Lantz-PTT)
W87-01733

PHYSIOLOGICAL EFFECTS OF SOUTH LOUISIANA CRUDE OIL ON LARVAE OF THE AMERICAN LOBSTER (HOMARUS AMERICANUS),
Woods Hole Oceanographic Institution, MA.
J. M. Capuzzo, and B. A. Lancaster.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 405-423, 4 fig, 5 tab, 35 ref. Dept. of Interior Contract No. AA 551-CT9-5.

Descriptors: *Physiological effects, *Oil pollution, *Larvae, *Lobsters, *Water pollution effects, Lethal limits, Toxicity, Respiration, Excretion, Ammonia, Oxygen, Nitrogen, Larval growth stage, Metabolism, Metamorphosis, Growth.

The sublethal effects of exposure to 0.25 ppm South Louisiana crude oil on larvae of the American lobster were evaluated. Respiration rates, ammonia excretion rates and O:N ratios were monitored at 24-hr and 72-hr during a 96-hr exposure period. Significant reductions in respiration rates and O:N ratios were detected for all larval stages after 72-hr exposure, indicating an increased demand on protein catabolism as a result of oil exposure. In further studies the effect of crude oil on the molt of stage IV larvae to the postlarval form (stage V), and the recovery potential of lobsters transferred to clean seawater, were investigated. Significant differences in all of the physiological parameters were detected between control and oil-exposed lobsters during exposure and post-exposure periods. Energy metabolism of larval and juvenile lobsters is apparently affected by crude oil exposure in the laboratory, and recovery is not immediate in the post-exposure period. These changes in energetics may become particularly critical during metamorphosis of larval lobsters

and the transitional period between pelagic and benthic habits. Understanding these responses of larval lobsters to acute oil exposures will provide scientists with a better basis for predicting the overall impact of oil spills on lobster populations. (See also W87-01717) (Lantz-PTT)
W87-01734

EXCRETION OF AROMATIC HYDROCARBONS AND THEIR METABOLITES BY FRESHWATER AND SEAWATER DOLLY VARDEN CHAR,
California State Univ., Chico. Dept. of Biological Science.
For primary bibliographic entry see Field 5B.
W87-01735

EFFECTS OF PETROLEUM HYDROCARBONS ON THE GROWTH AND ENERGETICS OF MARINE MICROALGAE,
Florida State Dept. of Environmental Regulation, Tallahassee.
J. E. Armstrong, S. W. G. Fehler, and J. A. Calder.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 449-466, 7 fig, 2 tab, 29 ref. NSF Grant OCE-76-82842.

Descriptors: *Water pollution effects, *Oil pollution, *Hydrocarbons, *Growth, *Microalgae, Marine environment, Biochemistry, Kinetics, Enzymes, Adenosine triphosphate, Photosynthesis, Bioaccumulation.

The short and long term effects of oil water-soluble fractions and specific compounds on the growth, electron transport systems, and kinetics of selected enzymes werre studied. Water-soluble petroleum hydrocarbons in general can be classified as non-specific metabolic inhibitors. Chronic effects to marine microalgae include a reduction in the cellular ATP pools with or without a concomitant reduction in the rate of growth. Exposure of microalgae to oil water-solubles inhibits photosynthetic electron transport as measured by photosynthetic oxygen evolution, medium alkalization, and initial uncoupling of oxidative phosphorylation as indicated by an increased respiratory oxygen consumption. Inhibition or an enhancement of the initial reaction rate of specific enzyme or enzyme systems of microalgae can be attributed to petroleum water-solubles and specific hydrocarbons. The significance of these alterations in specific enzyme activities are not clear at present. Oil water-solubles inhibit photosynthetic reactions at very low dose levels suggesting direct action on the electron transport systems by specific compounds or classes of compounds, likely the N, S, O - substituted aromatics. Long-term effects such as reduced ATP pools and extended lags in growth are more likely caused by the uptake and incorporation of aromatic hydrocarbons into the cell membrane. (See also W87-01717) (Lantz-PTT)
W87-01736

STUDY OF THE RECOVERY OF A MARINE ISOPOD (SPHAEROMA QUADRIDENTATUM) FROM PETROLEUM-INDUCED SENSITIVITY,
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
W. Y. Lee, and J. A. C. Nichol.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 467-482, 4 tab, 27 ref. NSF Grant No. GX-37345.

Descriptors: *Isopods, *Water pollution effects, *Sensitivity analysis, *Oil pollution, *Recuperation, Marine environment, Ecological effects, Survival, Toxicity, Sea water, Bioaccumulation, Oil spills, Chemical analysis.

Experiments were designed to determine (a) whether offspring of water soluble fractions of a No. 2 fuel oil (WSF)-exposed isopods become less resistant to WSF in terms of rates of development, reproduction, and survival, and (b) the number of generations it would take to recover from such exposure. Chronic exposure of juvenile isopods to low levels of WSF resulted in a less resistant F sub 1 generation. Petroleum-induced susceptibility lasted for about 1 to 2 generations when progeny of exposed isopods were grown in WSF-free sea water. Based on the life cycle of Saphoeroma quadridentatum observed in the laboratory, treated isopods required only 1/2 to 1 year to recover in WSF-free sea water. This short time interval was related to published data on the rates of accumulation and depuration of petroleum compounds by marine invertebrates. The rapid loss of accumulated hydrocarbons in clean sea water was probably the main reason why petroleum-induced sensitivity did not persist over a long period of time. Isopods in this study recovered more rapidly than the fauna in an oil-spill site. Since recovery of isopods took place in WSF-free sea water, the estimated time interval should be considered only as the minimum time period for a population to recover following an oil spill. However, when applying laboratory results to a field study, the authors suggest that other factors such as the chemical characteristics of oil and its persistence in the environment must be also taken into account. (See also W87-01717) (Lantz-PTT)
W87-01737

ECOLOGICAL PERSPECTIVE OF THE EFFECTS OF MONOCYCLIC AROMATIC HYDROCARBONS ON FISHES,
National Marine Fisheries Service, Tiburon, CA. Tiburon Lab.
J. A. Whipple, M. B. Eldridge, and P. Benville Jr.
IN: Biological Monitoring of Marine Pollutants, Proceedings of a Symposium on Pollution and Physiology of Marine Organisms, Milford, Connecticut, November 7-9, 1980. Academic Press, New York, 1981. p 483-551, 9 fig, 12 tab, 103 ref.

Descriptors: *Ecological effects, *Aromatic compound, *Hydrocarbons, *Fish, *Water pollution effects, San Francisco Bay, California, Bioaccumulation, Population, Dynamics, Growth stages, Physiological ecology, Benzene, Toluene, Xylenes, Ethylbenzene, Bass, Flounder, Herring, Anchovy, Salmon.

Monocyclic aromatic hydrocarbons (MAH) and their potential effects on aquatic resources are prevalent in estuarine ecosystems such as the San Francisco Bay-Delta, and may constitute a chronic pollution threat. These toxic petrochemicals, interacting with other pollutants, could cause quantitative reductions in the production of fish populations by decreasing growth, reproduction, egg viability, larval recruitment and survival. There are also qualitative effects on fisheries, such as condition of fish flesh and increased parasitism and disease. The sources and fates of MAH and their effects on fishes are summarized. The chronic effects of monoaromatics are examined in the context of a qualitative conceptual model, suggesting interactive effects of inherent environmental factors (abiotic and biotic). Variability in uptake, bioaccumulation and effects of monocyclics is considered in relation to inherent differences in fishes. The interaction of these inherent differences with temperature, salinity, pollutants and parasitism) is also discussed. Monocyclic aromatics discussed include: benzene, toluene, xylenes, ethylbenzene and substituted benzenes. Species discussed include: striped bass, starry flounder, Pacific herring, northern anchovy and Chinook salmon. The possible relationship of selected genotypic differences to variability in uptake, bioaccumulation and effects is discussed for striped bass and starry flounder. Differences among the following life history stages also occur: spawning adults, gametic eggs, spawned eggs, embryos, larvae, juveniles and non-spawning adults. Larvae, for example, appear to bioaccumulate very high levels of monocyclic aromatics. Many responses appear to be nonspecific responses to pollutant stress, but some specific effects (e.g., blood parameters) may also occur. (See also W87-01717) (Lantz-PTT)
W87-01738

REGIONAL DISTRIBUTION OF SOME WATER QUALITY VARIABLES IN FINNISH COASTAL WATERS,
For primary bibliographic entry see Field 5B.
W87-01744

EFFECT OF ACIDIC PRECIPITATION ON AMPHIBIAN BREEDING IN TEMPORARY PONDS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Dept. of Biology.
J. Freda, and W. A. Dunson.
Air Pollution and Acid Report No. 22, Biological Report 80(40-22), November 1985. 85 p, 14 fig, 18 tab, 73 ref, 3 append. USDI FWS Coop. Agreement 14-16-0009-154B.

Descriptors: *Acid rain, *Water pollution effects, *Amphibians, *Ponds, *Pennsylvania, Hydrogen ion concentration, Frogs, Salamanders, Lethal limit, Survival, Sodium.

This study assessed the impacts of acid deposition on amphibian breeding in temporary ponds in Pennsylvania by investigating the lowest pH's at which embryos could hatch, the physiological effects of low pH on amphibian larvae, pond chemistry and the influence of rainfall on pond pH, and the effect of pond pH on embryonic survival and local distribution of Ambystoma jeffersonianum and Rana sylvatica. At very low pH's, embryos stopped development soon after exposure. At higher but still lethal pH's, embryos became curled and failed to hatch. Embryos of Ambystoma were able to hatch even though they were curled, but R. sylvatica became trapped and died. Acute exposure to low pH's depressed sodium resulting in death. Increasing the external calcium concentration extended survival time by slowing the loss of sodium. Chronic exposure to low pH's resulted in reduction in body sodium but to a lesser degree. R. sylvatica tadpoles from a low pH pond had lower body sodium than tadpoles from a nearby high pH pond. Tadpoles from both ponds placed in a low pH pond underwent higher sodium efflux than when placed in the high pH pond. In studying the effect of low environmental pH, A. jeffersonianum was intolerant of low pH and was absent from most acidic ponds. R. sylvatica was tolerant and was found in ponds with the lowest pH. (Author's abstract)
W87-01755

5D. Waste Treatment Processes

TOXIC AND HAZARDOUS WASTES: PROCEEDINGS OF THE SEVENTH MID-ATLANTIC INDUSTRIAL WASTE CONFERENCE, JUNE 23-25, 1985.
Technomic Publishing Co., Lancaster, PA. 1985. Edited by Irwin J. Kugelman. 587 p.

Descriptors: *Toxic wastes, *Hazardous wastes, *Conferences, *Industrial wastes, Biological treatment, Physicochemical treatment, Pretreatment of water, Groundwater, Land disposal, Recycling, Sludge.

Mid-Atlantic Industrial Waste Conferences are designed to provide a forum for interchange of new technical as well as nontechnical solutions for industrial pollution control problems of the region. They provide an opportunity for the regulatory agencies, industries, universities, and consulting engineers to exchange information regarding their various activities. The theme of the Seventeenth Conference was: Focus on Problem Solving. Technical sessions included: biological treatment, pretreatment, physical chemical treatment, groundwater, land application and liners, resource recovery, hazardous waste, metals and industrial waste, sludge management, and, safety and right-to-know. This book, which is an outgrowth of these proceedings, is intended to provide a state-of-the-art synopsis of contemporary practice in the control of industrial, toxic, and hazardous wastes. (See also W87-00833 through W87-00869) (Author's abstract)
W87-00832

WASTE TREATMENT AND METHANE PRODUCTION USING THE ANAEROBIC FLUIDIZED BED SYSTEM,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
W. K. Shieh, J. D. Keenan, and C. T. Li.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 6-15, 8 fig, 9 ref.

Descriptors: *Wastewater treatment, *Methane, *Anaerobic fluidized beds, Anaerobic digestion, Fluidized bed process, Cost analysis, Biomass, Recycling, Chemical oxygen demand.

The anaerobic fluidized bed (AFB) system is a recent process innovation in anaerobic biotechnology which has been demonstrated to be highly cost-effective for liquid waste treatment, for biomass conversion, and for biochemical recovery and production. Unlike the conventional biofilm systems in which the growth support media are fixed in space either by gravity or by direct attachment to the reactor wall, an AFB system retains the growth support media in suspension by drag forces exerted by the upflowing wastewater. Immobilization of microorganisms on the small, fluidized media results in a very high reactor biomass holdup which enables the system to be operated at significantly higher liquid throughputs with practical absence of biomass washout. Because the AFB system is still at an early stage of development, research efforts are needed to gain better insight into the complex nature of the system in order to develop a more rational design and control procedure. This paper reports and discusses a laboratory investigation on the efficacy of the AFB system for liquid waste treatment and methane production. The glucose was used as the main substrate. The following specific conclusions can be drawn: (1) more than 90% of feed COD can be removed in an AFB system up to COD loading of approximately 40 kg/cu m/day when the starting compound is glucose, (2) About 332 liter of methane are produced/kg COD removed in an AFB system and this methane production rate is independent of the COD loading applied. The observed methane production rate is 93% of the theoretical maximum value when the starting compound is glucose, (3) The COD removal efficiency of an AFB system becomes independent of feed COD concentration providing that HRT is maintained above a certain level, (4) The AFB system is capable of retaining a very high biomass holdup even at a low feed COD concentration, (5) The distribution of biomass holdup in an AFB system is relatively uniform because of the completely mixed conditions maintained and the continuous biofilm sloughing process induced by the effervescence caused by rising methane gas bubbles, and, 6) The continuous biofilm sloughing process observed in this investigation eliminates the requirement for intentional sludge wasting. (See also W87-00832) (Lantz-PTT)
W87-00833

INTERMITTENT BIOLOGICAL TREATMENT OF HAZARDOUS WASTES,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
A. S. Weber, and M. R. Matsumoto.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 16-28, 9 fig, 7 ref.

Descriptors: *Biological treatment, *Hazardous wastes, *Intermittent treatment, *Industrial wastes, Combined treatment, Chemical oxygen demand, Groundwater pollution, Leachates, Physicochemical treatment.

From 1970 through 1977, Pollution Abatement Services, Inc. operated a high-temperature liquid waste incinerator facility in Oswego, New York. During that time, a wide variety of inorganic and organic wastes infiltrated surface and groundwaters contiguous to the site. Following its closure in 1977, a number of remedial measures were proposed and implemented at the PAS site to alleviate surface problems. Treatment process requirements are unique at the PAS site because of low groundwater and leachate pumping rates. To achieve cost effective operation of the planned facilities, frequency of treatment is expected to be no greater than once a week, and may be as long as once every 5 weeks. Thus, treatment processes that can be operated on an intermittent basis are required. Motivated by similar problems with physicochemical treatment alone several studies have been conducted by industrial concerns to assess the biotreatability of high strength chemical wastes and/or leachates. Based on the experimental results of the PAS groundwater treatability study, biological treatment in conjunction with activated carbon must be used to achieve an acceptable effluent quality. An added benefit of the combined treatment system is a reduction in carbon usage. These findings coincide with results of recent studies conducted by industrial concerns. However, on the basis of the preliminary experimental data, the proposed bioreactor can reduce PAS groundwater COD concentrations by greater than 70% under the worst conditions (no acclimation) and by greater than 85% if acclimation is achieved after reactor startup. When biological treatment is coupled with activated carbon a COD treatment efficiency of nearly 99% is achieved. Using the preliminary experimental results of the treatability study reported in this paper, a treatment flowsheet or aeration - precipitation - settling - biological treatment - granular activated carbon has been tentatively selected for the PAS site. (See also W87-00832) (Lantz-PTT)
W87-00834

TREATMENT OF NUTRIENT DEFICIENT WASTEWATERS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
J. H. Sherrard, and T. A. Broderick.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 29-40, 2 fig, 3 tab, 46 ref.

Descriptors: *Deficient elements, *Industrial wastewater, *Wastewater treatment, Biological oxygen demand, Nitrogen, Phosphorus, Sludge, Anaerobic digestion, Anhydrous ammonia, Calcium dihydrogen phosphate.

Addition of nitrogen and/or phosphorus to certain industrial wastewaters has long been recognized as necessary to reduce the biochemical oxygen demand (BOD). Microbial growth will not occur in the absence of nutrients and consequently organic laden wastewaters cannot be oxidized or stabilized. Addition of the correct amount of nutrients is desired for two reasons: (a) their purchase represents a cost which should be minimized, and (b) excess addition can results in receiving stream eutrophication problems. Convenient ratios relating BOD to nitrogen and phosphorus have been developed which serve as a guideline for nutrient supplementation. These ratios may be misleading if considered fixed, however. A thorough understanding of their development and the principles of microbial growth kinetics and treatment process stoichiometric fundamentals is necessary to apply the ratios intelligently in a given situation. Based on a thorough review of past and current practices regarding addition of nitrogen and phosphorus to nutrient deficient wastewaters it may be concluded that: (a) The maximum amount of nitrogen and phosphorus is being added to most industrial wastewaters with little regard being given to minimizing their addition. (b) Lower nutrient requirements can be realized by altering process operating conditions. High sludge ages (low-rate treatment) results in lower waste sludge production than low age sludge ages (high-rate treatment). Nutrients are required in direct proportion to waste sludge production. (c) Nitrogen and phosphorus are being added at concentrations far in excess of their requirements for anaerobic wastewater treatment systems. (d) To minimize chemical costs, anhydrous ammonia and calcium dihydrogen phosphate should be chosen as sources of nitrogen and phosphorus, respectively. (See also W87-00832) (Lantz-PTT)
W87-00835

APPLICATION OF BIOTHANE TECHNOLOGY FOR ANAEROBIC TREATMENT OF THERMAL SLUDGE CONDITIONING DECANT LIQUOR,
Biothane Corp., Camden, NJ.
For primary bibliographic entry see Field 5E.
W87-00836

COMMUNITY AND INDUSTRY WORKING TOGETHER TO SOLVE ENVIRONMENTAL PROBLEMS: TREATMENT OF PRETREATED COKE PLANT WASTEWATERS IN A MUNICIPAL SEWAGE TREATMENT PLANT,
Bethlehem Steel Corp., PA. Homer Research Labs.
R. E. Watkins, and W. H. Grim.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 57-73, 3 fig, 6 tab.

Descriptors: *Coke plants, *Industrial wastewaters, *Municipal wastewaters, *Wastewater treatment, *Corporate-Municipal cooperation, Regional planning, Environmental protection, Solid waste disposal, NPDES, Bethlehem, Pennsylvania.

During the past two years, the city of Bethlehem, PA, and the Bethlehem Steel Corporation have worked closely together in a full-scale test program designed to help the city's wastewater treatment plant comply with stringent State and Federal effluent standards and at the same time provide additional treatment of pretreated wastewaters from the coke works at Bethlehem Steel's Bethlehem Plant. This paper reviews the major results of that program and the significance of these cooperative efforts. Described here are: (1) Bethlehem's municipal wastewater plant, Bethlehem plant's coke plant wastewater treatment facilities, (2) the cooperative program between the city and Bethlehem Steel Corporation, and, (3) the results of sewage treatment plant (STP) operations, laboratory studies, and a full-scale plant trial. Based upon the results of this three phase cooperative program, we have reached the following conclusions: (1) The treatment of pretreated wastewaters from the Bethlehem Steel Coke plant in the city's STP is a technically feasible and environmentally sound option for treating these wastewaters; (2) The city's STP has the capacity to treat these wastewaters without any adverse effects on its ability to meet its NPDES Permit limitations; (3) Successful accomplishment of this project may provide Bethlehem Steel Corporation with the opportunity to avoid significant capital expenditures for add-on treatment facilities to meet federal effluent limitations. This in turn will allow the corporation to direct more funds into appropriate modernization projects which will help preserve jobs in the Bethlehem Plant and elsewhere in the City of Bethlehem; and, (4) The overall success of this project in the resolution of environmental problem is the result of a long-term and continuing cooperation between the City of Bethlehem and Bethlehem Steel Corporation. (See also W87-00832) (Lantz-PTT)
W87-00837

PRETREATMENT OF FLUORIDE BEARING WASTEWATERS,
BCM Engineers, Inc., Plymouth Meeting, PA.
J. V. Interrante, and G. A. Prior.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 74-92, 4 fig, 6 tab, 4 ref.

Descriptors: *Pretreatment of wastewater, *Fluoride, *Industrial wastewaters, Municipal water, Clarification, Precipitation, Alum, Ion exchange, Effluents.

The treatment of fluoride-bearing wastewaters has become an area of increasing concern as fluoride content in drinking water has become part of the public and regulatory agenda. High levels of fluoride in drinking water supplies are known to cause mottled enamel (dental fluorosis). This form of

dental disfigurement makes control of fluoride levels important to protect public health. Fluoride is not considered to be a toxic pollutant by the EPA, although it has been shown to be toxic to livestock and some forms of plants. The National Academy of Science has recommended upper limits for fluoride for continuous irrigation use in acidic soils (to protect against toxic effects on plants and crop yields), and for watering of livestock, of 1 mg/l and 2 mg/l, respectively. Fluoridation has also become a common practice in this country to prevent tooth decay, and some amount of fluoride in public water supplies is desirable. The EPA's Interim Primary Drinking Water Standards set limits of 1.4 - 2.4 mg/l. Since fluoride will not be removed by a municipal treatment plant, even an industry for which no categorical standard for fluoride exists may still have to pretreat for fluoride in order to comply with local water quality standards. This paper centers on fluoride pretreatment for the industries that discharge their industrial wastewater to local publicly owned treatment works (POTW). The various methods available for pretreatment of fluoride bearing wastewaters are listed below: (1) Precipitation/ clarification using lime and/or calcium chloride, although categorical standards of 18 mg/l cannot be achieved with this methodology employed as an end-of-pipe treatment. (2) Two-stage precipitation/clarification using aluminum sulfate to 'polish' the effluent from the Method 1 above, using alum treatment. Treatability testing indicates that effluent levels of less than 20 mg/l can be achieved with a two-stage precipitation/clarification treatment scheme. However, the costs associated with this would be higher than those for Method 1. (3) Precipitation/clarification using alum by itself in a one stage system. (4) Ion exchange using activated aluminum, is technologically feasible and can consistently achieve effluent levels well below 20 mg/l. However, this is the most expensive of the three methods described and would not be economically feasible except as a last resort. (See also W87-00832) (Lantz-PTT)
W87-00838

COST-EFFECTIVE WASTEWATER PRETREATMENT FOR THE SNACK FOOD INDUSTRY,
Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
E. D. Wetzel, and J. e. Howey.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 94-104, 2 fig, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Pretreatment of water, *Cost analysis, *Industrial wastewater, Snack foods, Primary wastewater treatment, Biological oxygen demand, Total suspended solids, Easton, Pennsylvania.

A snack food manufacturer in Easton, PA discharges 175,000 gallons of wastewater to the municipal treatment plant each week. This wastewater contains approximately 3,000 mg/l of BOD and TSS, resulting in a $100,000 surcharge for 1984 under the sewer use ordinance and the industrial waste management agreement. Three pretreatment alternatives were considered (no additional treatment, primary clarification with sludge dewatering, and, secondary treatment (biotower) with sludge dewatering), with the primary treatment system chosen as the most-effective. It is expected that the effluent BOD and TSS will be reduced by 40% and 75% respectively, amounting to a 50% reduction in the sewer use fees. The possible sale of belt press dewatered sludge to a local farmer would further reduce the net treatment cost to the industry. (See also W87-00832) (Lantz-PTT)
W87-00839

ALLENTOWN INDUSTRIAL WASTE PRETREATMENT PROGRAM,
Environmental Management Associates, Inc., Trexlertown, PA.
S. Naghshineh, W. Engle, J. McMahon, and P. Schwenzer.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 105-120, 2 fig, 4 tab.

Descriptors: *Pretreatment of water, *Industrial wastes, *Allentown, Water quality standards, Legal aspects, Wastewater treatment, Sludge, Cost analysis, Monitoring, Pennsylvania.

In accordance with the EPA's General Pretreatment Regulations, The City of Allentown is developing and implementing a local pretreatment program. The industrial wastewater pretreatment program will have a direct impact upon the nondomestic users of the Allentown wastewater treatment plant. Nondomestic, commerical and industrial discharges into the sewerage system are to be controlled. This paper discusses the procedures developed and steps taken to establish and implement the local pretreatment program, through discussion of: (1) a general treatment plant, (2) prohibited discharges and categorical standards, (3) industrial waste survey, (4) legal authority, (5) technical elements (wastewater treatment and sludge management), (6) local limits, (7) receiving waters, (8) cost analysis, and (9) compliance monitoring. (See also W87-00832) (Lantz-PTT)
W87-00840

ADSORPTION OF ARSENIC ON HYDROUS ALUMINUM OXIDE,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
M. M. Ghosh, and R. S. Teoh.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 139-155, 5 fig, 3 tab, 27 ref. EPA Grant No. R-809425919.

Descriptors: *Arsenic, *Wastewater treatment, *Aluminum hydroxide, *Adsorption, Ion exchange, Iron hydroxide, Chromium hydroxide, Arsenate, Arsenic, Chemical treatment, Hydrogen ion concentration.

Arsenic is one of several commonly occurring elements designated as a priority pollutant by the U.S. EPA under the Clean Water Act. Hydroxides of iron, chromium and aluminum strongly adsorb or form insoluble precipitates with arsenites and arsenates. This plays an important role in controlling arsenic concentration in the aquatic environment. The primary purpose of the present study was to develop an inexpensive treatment technology for arsenic removal using alumina suitable for small, unsupervised community water. Experiments were set up to establish removal capacities and the kinetics of arsenic adsorption on alumina under varying conditions of pH and competition from other ions. The effect of mass loading rate (MLR) and empty bed contact time (EBCT) were also studied in fixed beds of alumina. Further, spent alumina beds were regenerated to determine rejuvenated capacity and material loss, in an effort to evaluate process economics. Ion exchange with strong base anion resin is capable of complete arsenate removal; however, low exchange capacity of the resins examined seemingly makes this a less attractive treatment option for removing arsenic from water supplies. Adsorbing colloid flotation is also capable of high arsenate removal. Of the sorbents studied, activated alumina consistently achieved highest adsorption capacities and fastest rates. Adsorption of arsenic on activated alumina is greatly affected by pH, with maximum adsorption occurring at pH 8. (See also W87-00832) (Lantz-PTT)
W87-00841

COMPARATIVE PERFORMANCE OF ALUMINUM CHLORIDE, POLY-ALUMINUM CHLORIDE AND BLENDS IN WASTEWATER CLARIFICATION,
Villanova Univ., PA. Dept. of Chemical Engineering.
R. P. Kisciras, J. M. Courtney, and D. D. Joye.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 156-165, 4 tab, 4 ref.

Descriptors: *Aluminum chloride, *Poly-aluminum chloride, *Wastewater treatment, Cost analysis, Municipal wastewater, Performance evaluation, Turbidity, Sludge.

Aluminum chloride is an effective inorganic flocculant for wastewater clarification and can compete successfully with alum and ferric chloride in such uses. Poly-aluminum chloride (PAC). It is reputed to be a very effective coagulant, but its cost is high. This work explores the possibility of blending aluminum chloride and poly-aluminum chloride in order to obtain the high effectiveness of one at the lower cost of the other. Standard jar tests were used to determine experimentally the performance of such blends for clarifying actual wastewater, in this case influent to a municipal treatment plant. Blends of PAC and aluminum chloride have been shown to produce dramatically increased turbidity reduction for as yet undiscovered reasons. The optimum blend ratio showed dependence on the concentration of PAC, but all the optima appeared to be in the region of 40-60% AC. This gives a wide latitude of compositions in the blend for operating a treatment facility. Economic analysis of these blends indicated that significant cost savings for comparable turbidity reduction could be realized by using the blends. The blends proved far superior for turbidity removal, and they were superior in handling difficult-to-coagulate wastewater. Sludge volumes of the blends were comparable to those produced by aluminum chloride or poly-aluminum chloride alone. (See also W87-00832) (Lantz-PTT)
W87-00842

CARBON ADSORPTION ISOTHERMS FOR TRACE ORGANIC CONTAMINANTS IN PRIMARY EFFLUENTS FROM A PUBLICLY OWNED TREATMENT WORKS,
Occidental Chemical Corp., Grand Island, NY.
W. -C. Ying, E. A. Dietz, and V. J. Hoffman.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 166-185, 7 fig, 5 tab, 22 ref.

Descriptors: *Activated carbon, *Adsorption, *Isotherms, *Wastewater facilities, Phenols, Chloroform, Trichloroethylene, Benzene, Toluene, Chlorotoluene, Effluents, Trace organics.

Compared are carbon isotherms for trace-level organic compounds, which originate from industrial discharges, measured in pure water with those in Niagara Falls, publicly owned treatment works (POTW) primary effluents. Total phenols, chloroform, trichloroethylene, benzene, toluene, and chlorotoluene were selected for study, because they are among compounds of concern in application of carbon treatment for Niagara Falls POTW primary effluent. They represent several major classes of organic compounds, and pilot scale carbon column breakthrough curves for them were available for comparison with the respective isotherm capacities. Reliable and reproducible activated carbon adsorption isotherms for trace level organic compounds in both POTW primary effluents and pure water were obtained. Compared to the EPA protocol, the method developed in this investigation has two important advantages: smaller sample volume (43 ml vs 1 L) required, and more accurate capacity estimates since no organic carrier was employed in the sample preparation. The adsorptive capacities of activated carbon for organic contaminants in POTW primary effluent were significantly reduced due to presence of other adsorbable components of the background total organic carbon (TOC) in the effluent. To remove 100 micrograms/L of the target compound, the ratio of granular carbon requirement for treating a diluted POTW primary effluent (TOC = 16 mg/L) to that for a single compound solution was estimated to be: chloroform - 2.9, trichloroethylene - 5.5, toluene - 6.3, benzene - 7.0, and 0-chlorotoluene - 7.1. The capacity reduction for a specific compound was found to be dependent on the concentration ratio of the compound to TOC of the effluent sample. Less carbon would be required when the background TOC level is lower; data for another diluted POTW sample (TOC =

11 mg/L) showed that the corresponding numbers for chloroform and trichloroethylene were 2.5 and 3.9. For both effluent samples tested, the reduction in carbon capacity, as a result of competitive adsorption, was more for trichloroethylene than for chloroform. (See also W87-00832) (Lantz-PTT)
W87-00843

PILOT PLANT INVESTIGATIONS FOR THE REMOVAL OF TOXIC POLLUTANTS FROM INDUSTRIAL LAUNDRY WASTEWATER,
ARATEX Services, Inc., Encino, CA.
G. J. van Gils, and M. Pirbazari.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 186-195, 1 fig, 5 tab, 4 ref.

Descriptors: *Pilot plants, *Toxic wastes, *Industrial wastewater, *Wastewater treatment, Laundering, Dissolved air flotation, Calcium chloride, Aluminum sulfate, Organic carbon, Sedimentation, Coagulation.

Presented is a new treatment process was evaluated for the removal of toxic and conventional pollutants from industrial laundry effluents. The existing state-of-the-art technology consists of coagulation and flocculation followed by dissolved air flotation (DAF). This treatment relies on high dosages of inorganic coagulants such as calcium chloride or aluminum sulfate to remove the stable suspension of wastes created by the combined laundering action of detergency, heat and mechanical action. These chemicals, in addition to being costly, contribute to high volumes of sludge being generated through the treatment process. Furthermore, the separation of the flocculant particle from water using DAF is not foolproof, often resulting in pass-through of solids, suspended matter and incompletely coagulated wastes. It is concluded that the pilot plant performance is satisfactory in the removal of pollutants: (1) conventional pollutants as measured by total organic carbon and suspended solids, were removed 85% and 87% respectively, by the coagulation/settling process and 93% and 98% by the system as a whole; (2) metals were removed 70% and 99% by the coagulation/settling process alone; (3) volatile organic compounds were not removed satisfactorily through coagulation and settling, but were removed below detection limits by the combined ultrafiltration/activated adsorption process. (See also W87-00832) (Lantz-PTT)
W87-00844

PHOSPHORUS REMOVAL BY A COAL/ALUMINUM MEDIA FILTER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
A. G. Collins, L. R. Barker, and R. L. Johnson.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 196-206, 9 fig, 6 ref.

Descriptors: *Phosphorus removal, *Coal-aluminum filters, *Carbon filters, Coagulation, Filtration, Wastewater treatment, Industrial wastewater, Hydrogen ion concentration, Aluminum hydroxide.

The removal of phosphorus from domestic and industrial wastewater streams normally involves an expensive additional treatment step that, dependent on the process, may produce a voluminous sludge. The subject of this research was the investigation of an innovative process, a dual media (coal/aluminum) filter, that would substantially lower capital and operating costs of phosphorus removal while minimizing sludge production. The coal/aluminum media filter acts as a combined coagulation-filtration unit. Secondary domestic sewage effluent or untreated industrial effluent could be applied directly to the unit. The influent pH may require adjustment. The physical and operating characteristics of the coal/aluminum media filter, such as media size, bed depth and flow rate are comparable to those of a conventional single or dual media filter. The scope of this paper is threefold. A theoretical background for phosphorus removal in the coal/aluminum media filter is developed. The results of previous experimentation investigating the removal of turbidity and color are reviewed. Finally, the results of a pilot plant study conducted with a synthetic wastewater containing phosphorus are reported. Significant phosphorus removal can be achieved by use of the coal/aluminum media filter process. When the filter was charged with approximately 5.0 mg P/l effluent concentrations of less than 1.0 mg P/l could be achieved under particular operating conditions for at least 6 hours. The filtration rate needs to be in the region of 1.2 m/hr (0.50 gpm/sq ft) and the influent pH should be adjusted to approximately 5.0. The principal removal mechanisms appear to be the adsorption of the phosphorus to freshly precipitated aluminum hydroxide formed after the liberation of aluminum by the action of numerous galvanic cells within the coal/aluminum bed and direct precipitation of the phosphorus as an aluminum phosphate. (See also W87-00832) (Lantz-PTT)
W87-00845

TREATMENT OF COOLING TOWER WATER BY DISSOLVED AIR-OZONE FLOTATION,
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5F.
W87-00846

SUCCESSFUL CHEMICAL RECOVERY BY EVAPORATIVE AND MEMBRANE TECHNIQUES,
M. S. Bahorsky.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 326-333, 8 fig, 1 tab.

Descriptors: *Chemical recovery, *Evaporation, *Membrane filters, *Cost analysis, Sodium hydroxide, Sizing, Filtration, Chemical engineering, Biological oxygen demand, Industrial wastewater, Feasibility studies.

Generally useful features from the successful application of two chemical engineering processes used in the reclamation and reuse of two chemicals are described. The viewpoints developed are intended to be profitable to regulatory personnel, industrial management and engineering, and industrial consultants, with consideration to the fact that many dollars of savings have been prompted in the industrial sector by regulatory pressures. The first example involves the problem of highly alkaline discharges, a common occurence in the textile industry. First, for the recovery of sodium hydroxide from wastewaters, an evaporative methodology is used. The use of consultants is highly recommended to maintain the cost integrity of the project and the system. A post-recovery step to reduce colored material in the product is to inject chlorine gas. The chlorine, as seen in the slide, bleaches the liquor for more confident reuse, and provides desirable residual supplemental bleaching of the cotton fiber. The second engineering process is a pre-filtration/filtration process which eliminates sizing from the wastes, thereby reducing the high BOD which loading emits from the low-volume process used in textile production. Feasibility studies and cost analyses are conducted on both processes, with the eventual result probably being an increased use of pollution control technologies. (See also W87-00832) (Lantz-PTT)
W87-00855

SOLVENT WASTE REDUCTION AND RECOVERY,
Earth Technology Corp., Alexandria, VA.
D. L. Hazelwood, and B. J. Burgher.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 334-342, 1 tab, 7 ref.

Descriptors: *Solvents, *Industrial wastewater, *Waste recovery, Recycling, Filtration, Centrifugation, Sedimentation, Distillation, Chemical properties.

Numerous industrial operations result in waste solvent generation, e.g., part cleaning and degreasing, general plant clean-up and maintenance, painting, paint stripping, fuel tank cleaning, and printing. One of the largest sources of waste solvents is the preparation of metal surfaces for further processing by solvent and degreasing. In light of the large quantities of waste solvents from this source and the renewed interest in solvent recovery, the available technology, economics and applications/limitations of waste stream reduction techniques and on-site and off-site recovery systems are explored. Options available for recycling contaminated solvents include: (1) Direct sale of spent solvents to an off-site recycler; (2) 'Toll-back' off-site recycling wherein the recycled solvents are returned to the original user; (3) On-site recycling using devices dedicated to the solvent process and, (4) On-site recycling with detached units which can serve several waste-solvent generating operations. The primary factor which influences whether a facility recycles on-site or uses an off-site service is the long-term cost savings achievable. Small-volume solvent users cannot justify the costs of on-site recycling and are better served by off-site operations, although 50 gal/day batch distillation systems which cost under $5,000 are available. If the waste solvent is heavily contaminated with undissolved or immiscible materials, initial treatment prior to distillative recovery may prove cost effective. Mechanical separation techniques such as decanting, filtering, settling and centrifuging are effective pretreatment steps. Distillation is utilized to separate solvent mixtures and to remove dissolved impurities. Most distillation systems fall into one of five categories: (1) Batch distillation; (2) Steam distillation; (3) Continuous distillation; (4) Batch rectification; and, (5) Continuous rectification. All of these systems use heat to vaporize the solvent targeted for recovery. The vaporized solvent is then withdrawn from the heating area and condensed. Selection of an appropriate distillation system requires consideration of such factors as: solvent boiling point, separation desired, throughput requirements, contaminant type/characteristics, and distilled solvent specifications. (See also W87-00832) (Lantz-PTT)
W87-00856

RECOVERY OF SILVER FROM COD WASTE SOLUTIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. N. Durst, and W. R. Knocke.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 400-414, 8 fig, 8 ref.

Descriptors: *Silver, *Waste recovery, *Industrial wastewaters, *Chemical oxygen demand, Ion exchange, Chemical precipitation, Chemical properties, Cost analysis, Chemical recovery.

The chemical oxygen demand (COD) of wastewaters is routinely determined by most environmental laboratories using the dichromate reflux method. This test procedure generates a highly acidic waste solution containing approximately 0.01 M silver, mercury, iron and chromium, and 2.7 M sulfate ion concentrations, which have been classified as hazardous materials. Therefore, COD waste solutions must be disposed of using environmentally sound procedures. The disposal costs, in addition to the cost of large quantities of silver sulfate required to perform COD analyses, have provided an incentive for the recent development of techniques aimed at recovery and reuse of silver from COD waste solutions. The purpose of this series of studies was to determine the applicability of ion exchange methods for recovery and reuse of silver ions from COD waste solutions. In addition, precipitation of the remaining metal ions was considered as a means of reducing the volume of waste which would require regulated handling and disposal. The effect of high ionic strength conditions on ion exchange recovery of silver ions was also evaluated. The results obtained during this study indicate that recovery of silver may be accomplished through the use of ion exchange systems. However, the efficiency of removal noted and effective use of ion exchange resin capacity are strong functions of solution ionic strength. There

are certain practical advantages to the use of a recovery system such as the one described herein. First, it allows for the recovery and reuse of a chemical species like silver which is often an expensive chemical to purchase. Second, by incorporating a recovery step into the overall treatment system, the user of this technology retains the status of generator only with respect to Resource Conservation and Recovery Act guidelines. (See also W87-00832) (Lantz-PTT)
W87-00859

DESTRUCTION OF CADMIUM CYANIDE WASTE BY ALKALINE CHLORINATION TREATMENT,
Tennessee Univ., Knoxville. Dept. of Environmental Engineering.
B. T. Butcher, R. A. Minear, and R. B. Robinson.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 415-431, 3 fig, 4 tab, 10 ref.

Descriptors: *Cadmium, *Cyanide, *Industrial wastewater, *Chlorination, Wastewater treatment, Electroplating, Chemical analysis, Chemical treatment.

Cadmium is a component in fatigue-resistant alloys, solders, and nickel-cadmium storage batteries, as well as being used in rustproof electroplating for steel parts. The EPA has promulgated industrial effluent limitation guidelines on the electroplating of common metals. Cyanide is commonly employed as a complexing agent for cadmium and other metals used in the electroplating industry. Concentrated cyanide baths are used to hold metallic ions in solution while immersing the part into the plating solution. Following plating, the part is removed and rinsed of residual plating chemicals. This rinse, commonly known as 'drag-out', typically contains between 15 and 100 mg/l of the metal-cyanide complex. Conventional rinsing techniques produce a large amount of drag-out which must meet effluent limitation guidelines before discharge. The objective of this experimental investigation was to evaluate the effects of different oxidants and pH conditions on supernatant quality and sludge characteristics following alkaline chlorination of cadmium cyanide solutions. The study indicates that carbonate precipitation in the region of minimum cadmium solubility reduces the buffering capacity, and results in the decline of solution pH. Higher cadmium solubility results at this new pH value as predicted by theoretical cadmium carbonate solubility curves. The addition of supplemental carbonate will aid in maintaining pH at the desired level. (See also W87-00832) (Lantz-PTT)
W87-00860

COMBINED TREATMENT OF HEXAVALENT CHROMIUM WITH OTHER HEAVY METALS AT ALKALINE PH,
CH2M/Hill, Reston, VA.
T. E. Higgins, and B. R. Marshall.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 432-443, 15 fig, 1 tab, 5 ref.

Descriptors: *Hexavalent chromium, *Heavy metals, *Hydrogen ion concentration, *Wastewater treatment, Industrial wastewater, Case studies, Alkalinity, Chemical precipitation, Chemical reduction.

With the introduction of additional and more stringent pretreatment regulations, industries are often finding it difficult to meet their discharge requirements. Particularly hard hit are small facilities with wastes containing low concentrations of hexavalent chromium. Treatment of industrial wastewaters is difficult because hexavalent chromium exists in the form of either chromate or dichromate depending on the pH of the wastewater. Both are negatively charged ions that cannot be readily removed unless chemically reduced to the trivalent state. Chromium reduction, followed by hydroxide precipitation with other metals, is the established method of treatment. Chromium reduction is normally conducted as a separate process step at low pH (less than 3) using a reduced sulfur compound, such as sodium metabisulfite or sulfur dioxide, to contribute electrons to the reaction. Treatment complexity results from (a) the need either to segregate wastes or to treat all of the wastes for chromium reduction, and (b) the need to maintain separate acidic and alkaline processes. The quantity of chemical used for pH adjustment can be significant, especially for highly buffered wastes, due to the need to first acidify, then raise the pH, and finally neutralize the waste before discharge. Alternatively, an effective alkaline chromium reduction process can be consolidated with hydroxide precipitation, eliminating the need for waste segregation and greatly reducing the need for acid and caustic addition. This efficiency can be accomplished by alkaline reduction and precipitation using ferrous iron. The process is especially attractive for the treatment of mixed metal wastes containing low concentrations (less than 10 mg/l) of hexavalent chromium, or for neutral to alkaline wastes that are highly buffered. Three case studies are presented, which present data from the application of these processes to actual industrial wastewater treatment. (See also W87-00832) (Lantz-PTT)
W87-00861

NEW MEMBRANE TECHNOLOGY IN THE METAL FINISHING INDUSTRY,
Carltech Associates, Inc., Cranford, NJ.
P. Werschulz.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 444-454, 2 tab, 8 ref.

Descriptors: *Membranes, *Metal-finishing wastes, *Wastewater treatment, Sludge disposal, Chemical precipitation, Ion exchange, Flocculation, Resins, Wash water, Electroplating, Reverse osmosis.

This paper reviews the state of development of membrane technology and its application to metal finishing wastewater treatment. Metal finishing wastewaters, particularly those from electroplating rinses, can contain toxic heavy metals such as cadmium, chromium and lead. The two common treatments used are precipitation and ion exchange. The former, by precipitating the metal ions, produces a sludge that has to be disposed of in a secure landfill. In addition to the sludge, there are problems with chelating agents present in the rinse water that inhibit precipitation. Flocculants are sometimes added to aid in filtration. These significantly increase the bulk of the sludge. Ion exchange resins, while not producing a sludge, must be regenerated with strong acids or bases. The regenerating solution then must be handled for reprocessing or disposal. New technology is emerging that makes zero sludge, zero discharge, and recycling of metal possible. This paper first characterizes the rinse waters in the metal finishing industry. Particular emphasis is placed on the electroplating processes. Current membrane usage is discussed, which includes a brief definition and explanation of the many types of membranes available for this application. The composition and configurations of those commercially available are listed. (See also W87-00832) (Lantz-PTT)
W87-00862

TROUBLESHOOTING AND OPTIMIZING CLARIFIER AND BELT PRESS OPERATIONS,
Ashland Chemical Co., Boonton, NJ. Drew Industrial Div.
R. M. Golaszewski.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 486-496, 4 fig, 4 ref.

Descriptors: *Optimizations, *Troubleshooting, *Clarification, *Belt process, *Wastewater treatment, Solids, Sludge, Dewatering, Cost analysis, Design criteria.

Since untreated wastewater seldom meets discharge specifications, some form of liquid/solids separation must be performed to improve the quality. Undesirable solids, such as heavy metals, hardness salts, and organics must be removed before these waters are reused or discharged. Liquid/solids separation by gravity clarification and belt press sludge dewatering are the most common methods of suspended solids removal and concentration in wastewater treatment today. Since it is not uncommon to have hundreds of thousands or even millions of dollars invested in these pieces of capital equipment, it should be in the plant's best interest to make an effort to run their wastewater process at peak efficiency. Also, when one considers the consequences (sewer surcharges, high hauling costs, discharge fines, plant closure) of operating an effluent treatment system at less than design efficiency, it makes sense to pay attention to the part of the plant which has carried the undeserved stigma of 'no return on investment' long enough. The basic purpose of this paper is to provide tips on how to trouble-shoot clarifier and belt press problems before they get out of hand and what steps to take to optimize their operation. (See also W87-00832) (Lantz-PTT)
W87-00865

MANAGING RESIDUAL SOLID WASTES IN AN AIRCRAFT ENGINE MANUFACTURING FACILITY,
Garrett Turbine Engine Co., Phoenix, AZ. Plant Engineering Dept.
M. L. Schurger, P. Li, and F. J. Nixon.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 523-533, 1 fig, 5 tab.

Descriptors: *Solid wastes, *Aircraft, *Industrial wastes, Waste management, Environmental protection, Clean Water Act, Heavy metals, Cyanide, Solvents, Sludge, Waste treatment.

New and increasingly more stringent environmental regulations complicate the handling of hazardous waste generated in electroplating and metal finishing operations. The past few years have seen the promulgation and enforcement of two major environmental regulations that have had significant impacts on these industries. New regulations in effect by August, 1985 will further complicate hazardous waste disposal/recycle operations. The two major regulations include the Pretreatment Regulations for the Electroplating and Metal Finishing Categories and the Resource Conservation and Recovery Act (RCRA). In addition to metals and cyanide these regulations also address toxic organics. A list of 129 organic chemical substances is specified. No more than 2.13 ppm of the combination of any of the chemicals on the list can be in the discharge to the Publicly Owned Treatment Works. This list includes such widely used solvents as 1,1,1 trichloroethane, phenol, and toluene. Under the new RCRA Reauthorization, the jurisdiction has been expanded to include secondary materials that are solid and hazardous when recycled, recycleable materials that can be wastes and various recycling operations including: use constituting disposal, reclamation, and speculative accumulation. Also under the jurisdiction of the Reauthorized RCRA are secondary materials that are not solid and hazardous waste when recycled. Generators that had reclaimed or recycled material on-site may now be considered hazardous waste treatment facilities and subject to much more stringent requirements. Difficulties and costs associated with compliance with these regulations may force the generator to look into other options. The dilemma for the liquid hazardous waste generator is apparent. The approach taken by Garrett Turbine Engine Company to deal with these regulations is the subject of this paper. Discussed are in-plant technologies (for spent acid, cyanide and metal concentrated baths), treatment and recycling of these wastes, solvents, sludge treatment and future needs. (See also W87-00832) (Lantz-PTT)
W87-00868

ENVIRONMENTAL IMPACT STATEMENT: TALLAHASSEE-LEON COUNTY WASTEWATER MANAGEMENT, TALLAHASSEE, LEON COUNTY, FLORIDA.

Environmental Protection Agency, Atlanta, GA. Region IV.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-179705, Price codes: A13 in paper copy, A01 in microfiche. Final Report EPA 904/9-83-106, March 1983. 212 p.

Descriptors: *Wastewater treatment, *Environmental impact statement, Tallahassee, Leon County, Florida, Soil properties, T.P. Smith Wastewater Treatment Facility, Water conservation, Planning.

Future growth in wastewater generation can be handled by existing facilities at the T. P. Smith/Southwest treatment facility, Tallahassee, Florida, according to an environmental impact study. This area is suitable for on-site disposal systems and small community systems in growth areas. Drinking water supplies and wetlands ecology are not expected to be adversely affected by the chosen alternative. No federal action is recommended. (Cassar-PTT)
W87-00920

BIODEGRADATION OF CHLORINATED ETHENES BY A METHANE-UTILIZING MIXED CULTURE,
Cambridge Analytical Associates, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W87-00984

REMOVAL OF ENDOTOXIN FROM WATER BY MICROFILTRATION THROUGH A MICROPOROUS POLYETHYLENE HOLLOW-FIBER MEMBRANE,
Mitsubishi Rayon Co. Ltd., Nagoya (Japan). Product and Development Center.
For primary bibliographic entry see Field 5F.
W87-00985

EXPERIMENTAL DETERMINATION OF INTRINSIC KINETIC COEFFICIENTS FOR BIOLOGICAL WASTEWATER TREATMENT SYSTEMS,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
W. K. Shieh, and L. T. Mulcahy.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 1-10, 1986. 5 fig, 1 tab, 24 ref.

Descriptors: *Kinetics, *Mass transfer phenomena, *Biological wastewater treatment, *Rotating disk biofilm reactor, *Denitrification, *Carbon, *Nitrogen, *Wastewater treatment, Wastewater treatment facilities.

Laboratory investigation demonstrated that intrinsic kinetic coefficients useful for examination of mass transfer phenomena in biological wastewater treatment can be measured easily using a rotating disk biofilm reactor (RDBR). Both the experimental procedure and the numerical analysis involved are simplified because of the linear geometry of the experimental apparatus used. The RDBR provides a relatively simple, yet rigorous, means for examination of both intrinsic and mass transfer-limited kinetics and it allows for a direct measurement of intrinsic kinetic coefficients and biological parameters. The intrinsic biological denitrification reaction with methanol as the organic carbon is zero-order; the intrinsic kinetic coefficients of biological denitrification measured here were k (intrinsic zero-order denitrification rate) = 2.875 mg NO3-N/mg volatile solids (VS)-day and D sub e (mean nitrate-nitrogen effective diffusivity) = .00000815 + or - .00000617 sq cm/s. Moreover, the biofilm dry density of denitrification biofilm was approximately 65 mg VS/ml for biofilm thickness up to about 350 micron. The intrinsic kinetic coefficients measured using the rotating disk biofilm reactor are capable of predicting the NO3-N profiles observed in a steady-state, plug-flow fluidized bed biofilm reactor operated under the identical conditions as the rotating disk biofilm reactor. (Rochester-PTT)
W87-00990

IMPLICATIONS OF THE IAWPRC HYDROLYSIS HYPOTHESIS OF LOW F/M BULKING,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
G. A. Ekama, and G. v. R. Marais.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 11-19, 1986. 4 fig, 29 ref.

Descriptors: *Bulking, *Bulking sludge, *International Association for Water Pollution Research and Control, *Activated sludge systems, *Biological wastewater treatment, Chemical oxygen demand, Phosphorus, Hydrolysis hypothesis, Design standards.

An alternative procedure to the Chudoba, Grau, and Ottova (1973) selection criterion for low F/M filamentous bulking was developed. This became necessary upon acceptance of the International Association on Water Pollution Research and Control (IAWPRC) hydrolysis hypothesis for readily biodegradable chemical oxygen demand (COD) generation from particulate biodegradable COD. The additional source of readily biodegradable COD becomes the object of competition between filaments and floc-formers. Although there are many assumptions in the alternative criterion that still require experimental testing, the authors feel that the the hydrolysis hypothesis has given an additional direction in examining the low F/M bulking problem in activated sludge systems, and in particular, in biological P removal ones. Experimental observations supporting the new criterion are presented. (Rochester-PTT)
W87-00991

SUBSTRATE REMOVAL MECHANISM FOR SEQUENCING BATCH REACTORS,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
D. Orhon, Y. Cimsit, and O. Tunay.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 21-33, 1986. 12 fig, 3 tab, 12 ref.

Descriptors: *Sequencing batch reactors, *Growth-limited models, *Substrate removal, *Settling, *Wastewater treatment facilities, Biological wastewater treatment, Chemical oxygen demand.

A growth-limited model for exploration of all factors affecting substrate removal in sequencing batch reactors (SBR) is proposed and experimental observations verifying it are presented. The authors' conclusions include the following: overall process efficiency of SBR is more dependent on the settling mechanism than in conventional biological systems so manipulation of operation modes appears to offer good potential for the improvement of the biomass settling properties; the impact of kinetic parameters is quite noticeable at which soluble substrate removal occurs and this impact should be considered in conjunction with possible optimization of system operation when dealing with strong wastes; and if the system performance is to be evaluated in terms of overall parameters such as chemical oxygen demand, residual substrate generation appears to be much more critical than the conventional removal concept. (Rochester-PTT)
W87-00992

MODELING MASS TRANSFER IN BIOLOGICAL WASTEWATER TREATMENT PROCESSES,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. C. Kissel.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 35-45, 1986. 2 fig, 7 tab, 46 ref. EPA Grant CR 808851.

Descriptors: *Mixed-culture biofilm models, *Trickling filters, *Biological wastewater treatment, *Wastewater treatment facilities, *Mass transfer, Anaerobic trickling filters, Low-rate trickling filters, Rapid sand filters, Granulated activated carbon columns, Fluidized beds.

Estimates of parameters characterizing intrasolid, liquid/solid, and gas/liquid mass transport phenomena in biological treatment systems are presented and discussed. Collective and individual effects of mass transfer resistances are illustrated by computer simulation of a high-rate trickling filter. Based on estimates of liquid/solid mass transfer coefficients from correlations developed from abiotic systems, it appears that: (1) in fixed-film biological processes, significant external mass transfer resistance is likely for large media, low flow systems (anaerobic filters, low-rate trickling filters), unlikely for small media, high flow systems (rapid sand filters, granulated activated carbon columns, fluidized beds), and possible in intermediate ranges; and (2) in suspended growth biological processes, internal and external mass transfer resistances are of similar magnitude. Use of a mixed-culture biofilm model to simulate trickling filter produced results conforming to generally observed phenomena. (Rochester-PTT)
W87-00993

MODEL FOR SINGLE-SLUDGE WASTEWATER TREATMENT SYSTEMS,
Clemson Univ., SC.
C. P. L. Grady, Jr., W. Gujer, M. Henze, G. v. R. Marais, and T. Matsuo.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 47-61, 1986. 5 tab, 19 ref.

Descriptors: *Wastewater treatment, *Single-sludge treatment system, *International Association for Water Pollution Research and Control, *Biological wastewater treatment, Carbon oxidation, Nitrification, Denitrification, Heterotrophic biomass, Autotrophic biomass, Stoichiometric coefficients, Particulate organic matter, Organic nitrogen, Mathematical models.

In 1983 the International Association for Water Pollution Research and Control formed a task group to facilitate the application of practical models to the design and operation of biological wastewater treatment systems. An outline is presented of the model developed for single-sludge systems performing carbon oxidation, nitrification, and denitrification. The model includes seven fundamental processes: aerobic growth of heterotrophic biomass, anoxic growth of heterotrophic biomass, aerobic growth of autotrophic biomass, decay of heterotrophic biomass, decay of autotrophic biomass, hydrolysis of entrapped particulate organic matter, and hydrolysis of entrapped organic nitrogen. The model is presented in the form of a matrix that utilized stoichiometric coefficients to couple the components of the model with the process rate expressions acting on them. (Author's abstract)
W87-00994

EVALUATION OF THE GENERAL ACTIVATED SLUDGE MODEL PROPOSED BY THE IAWPRC TASK GROUP,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
P. L. Dold, and G. v. R. Marais.
Water Science and Technology WSTED4, Vol. 84, No. 6, p 63-89, 1986. 14 fig, 2 tab, 42 ref.

Descriptors: *Activated sludge models, *International Association for Water Pollution Research and Control, *Biological wastewater treatment, *Wastewater treatment facilities, Mathethematical models, Aeration, Contact beds, Nitrification, Denitrification.

The antecedents to the general activated sludge model proposed by the International Association for Water Pollution Research and Control (IAWPRC) Task Group on modeling of activated sludge systems are reviewed. Modifications to the Task Group model are proposed and sets of experimental data from a wide range of single sludge systems are presented to validate the model. Model validation results are described for single aerobic reactor-cyclic loading, aerobic batch experiments, contact stabilization system-cyclic loading, aerobic digestion, and anoxic/aerobic (nitrification/denitrification) systems. (Rochester-PTT)
W87-00995

PROCEDURES FOR DETERMINING INFLUENT COD FRACTIONS AND THE MAXIMUM SPECIFIC GROWTH RATE OF HETEROTROPHS IN ACTIVATED SLUDGE SYSTEMS,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
G. A. Ekama, P. L. Dold, and G. v. R. Marais.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 91-114, 1986. 8 fig, 3 tab, 12 ref.

Descriptors: *Chemical oxygen demand, *Wastewater treatment, *Municipal wastewaters, *Biodegradability, *Heterotrophs, Bacterial physiology, International Association for Water Pollution Research and Control, Mass loss rate constants, Mathematical models.

The influent chemical oxygen demand (COD) of municipal wastewaters has been categorized into fractions: readily (soluble) and slowly (particulate) biodegradable, and soluble and particulate unbiodegradable. Procedures are presented for determining the division of influent COD into these categories; experimental methods are described for determining the maximum specific growth rate of the heterotrophs within the International Association for Water Pollution Research and Control Task Group model structure. Some of the procedures depend on knowledge of the heterotroph yield and endogenous mass loss rate constants. Comments are made on suggested values. (Author's abstract)
W87-00996

NITRATE VERSUS OXYGEN UTILIZATION RATES IN WASTEWATER AND ACTIVATED SLUDGE SYSTEMS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
M. Henze.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 115-122, 1986. 1 fig, 5 tab, 15 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Biological wastewater treatment, *Nitrates, *Oxygen, *Respiration, Mathematical models, Wastewater oxidation, Biomass.

Respiration rates for nitrate and oxygen are compared. Raw wastewaters vary much in these rates and the same holds for activated sludge systems. The denitrifying activity may range from 0-80% of the oxygen activity. It is important to take these variations into consideration when modeling complex activated sludge processes. Of similar importance are the amounts of active biomass in the raw wastewater, as these amounts can exceed those produced in the activated sludge plant itself, and thus can influence significantly the overall composition of the active biomass. (Author's abstract)
W87-00997

ACTIVATED SLUDGE PROCESS MODELS FOR TREATMENT OF TOXIC AND NONTOXIC WASTES,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, Jr., A. F. Rozich, and E. T. Gaudy.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 123-137, 1986. 10 fig, 2 tab, 15 ref.
Office of Water Research and Technology Research Project A-051-Del.

Descriptors: *Activated sludge process, *Toxins, *Wastewater treatment facilities, *Monod function, Haldane equation, Biological wastewater treatment, Clarifiers, Toxicity, Bacterial physiology, Growth, Mathematical models, Pilot plants.

Design and operation aspects of use of activated sludge processes for treatment of both toxic and nontoxic wastes are presented. After developing an acclimated biomass that is capable of degrading a particular waste, it is prudent to determine the nature, inhibitory or noninhibitory, of the microbial growth rate equation as a function of exogenous substrate concentration. For noninhibitory wastes, the Monod function can be employed for relating specific growth rate to soluble substrate concentration in the clarifier effluent. Inhibitory wastes require the use of an inhibition function such as the Haldane equation. Analysis of the design and operational equations for activated sludge systems underscores the significance of the critical, or peak, growth rate, which is characteristic of systems treating inhibitory wastes. If this growth rate is exceeded in continuous flow units treating toxicants, rapid effluent deterioration and reactor failure can occur. This can be demonstrated analytically and verified in pilot plant studies. The predictive power of the kinetic model for establishing the critical operating conditions in activated sludge systems also is discussed. (Author's abstract)
W87-00998

MODELLING NITRIFICATION IN PLANT SCALE ACTIVATED SLUDGE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
P. J. Bliss, and D. Barnes.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 139-148, 1986. 4 fig, 1 tab, 14 ref.

Descriptors: *Nitrification, *Activated sludge, *Wastewater treatment, *Biological wastewater treatment, *Bacterial physiology, *Mathematical models, Mixed liquor suspended solids, Prediction, Sludge, Biomass, Oxygen, Growth.

Nitrificatien performance data from an activated sludge plant were simulated using a simple model based on growth requirements of nitrifiers only and a complete-mix flow pattern. The model best accounted for the plant data under high peak flows and ammonia loadings and confirmed the observation that high peak loadings cannot be fully compensated by increasing the safety factor applied to theoretical mean cell residence time. Difficulties in control of dissolved oxygen and mixed liquor suspended solids concentration under high transient loads also adversely affected nitrification. Overall ammonia oxidation rates of the sludge, under the imposed nitrogen and carbon loadings, varied from 2.5 to 1.3 mg/g per hr at mean cell residence times of 3-4 and 9-10 days, respectively. Adaptation of the model to predictive use requires modification to include overall biomass growth, oxygen relationships, and sludge recycle arrangement. (Author's abstract)
W87-00999

EXPERIMENTAL EVALUATION OF MODELLING ALTERNATIVES AND PROCESS PARAMETERS FOR THE SINGLE-SLUDGE NITROGEN REMOVAL SYSTEM,
Technion - Israel Inst. of Tech., Haifa.
Y. Argaman, and A. Brenner.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 149-161, 1986. 7 fig, 2 tab, 18 ref.

Descriptors: *Nitrogen removal, *Biological wastewater treatment, *Wastewater treatment facilities, *Mathematical models, Ammonia, Volatile suspended solids, Nitrification, Denitrification, Bacterial physiology, Chemical oxygen demand.

Experiments were carried out on bench-scale units operated continuously in the single-sludge mode. A synthetic feed consisting of glucose, acetate, ammonium chloride, and essential elements was used. The results served to examine the validity of various expressions for process modelling and to derive several process parameters. For effluent ammonia of approximately 0.5 mg/l, a specific denitrification rate of 0.75 g NH4(+)-N/g volatile suspended solids (VSS) per day was selected. The maximum nitrification rate exceeded 1.9 g NH4(+)-N/g VSS per day and the maximum denitrification rate was 1.7 g NO3(-)N/g VSS per day. The yield and decay coefficients were determined as 0.31 g VSS per g chemical oxygen demand (COD) and 0.018 per day, respectively, for the the heterotrophs, and 0.246 g VSS per g NH4(+)-N and 0.007 per day, respectively, for the autotrophs. Microbial counts were in qualitative agreement with predicted values. (Author's abstract)
W87-01000

APPLICATION OF A MATHEMATICAL MODEL FOR ACTIVATED SLUDGE TREATMENT,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Takacs.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 163-174, 1986. 4 fig, 2 tab, 5 ref.

Descriptors: *Activated sludge process, *Mathematical models, *Wastewater composition, *Biological wastewater treatment, *Wastewater treatment facilities, Activated carbon, Microcomputers, Batch process, Continuous process, Temperature, Langmuir isotherm, Pflanz equation, Settling.

Modification and application of the Dold, Ekama, and Marais dynamic model for activated sludge treatment are described. The constants representing the different organic fractions of the wastewater as well as the temperature were replaced by variables or functions in the model describing continuous operation. Another change involved the value of the maximal substrate degradation rate constants. The option of changing these values according to a function when approaching a new equilibrium under new operational conditions (e.g., starting up a plant or starting activated carbon addition) was provided. The model was supplemented by the Langmuir isotherm, and thus became capable of simulating the powdered activated carbon addition process. Also, the Pflanz equation concerning settling and recirculation was applied for the description of the continuous operation. The model, extended and run on personal computers, was verified on the basis of both batch and continuous experiments. Industrial application of the model at the Balatonfuzfo Nitrochemical Works is described. (Author's abstract)
W87-01001

KINETIC ASPECTS OF PLANNING AND OPERATING ACTIVATED SLUDGE SYSTEMS,
Budapesti Mueszaki Egyetem (Hungary). Dept. of Agricultural Chemical Technology.
A. Donath-Jobbagy, and J. Hollo.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 175-188, 1986. 11 fig, 7 tab, 1 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Mathematical models, *Substrate removal, *Wastewater treatment facilities, Batch process, Continuous process, Management planning, Process control, Chemical oxygen demand, Dairy industry, N-dodecylbenzene sulfonic acid, Detergent, Wastewater composition.

A 'black-box' substrate removal model was developed for predicting the operation of activated sludge treatment plants on the basis of laboratory-scale experiments. Data acquisition for predicting results of continuous operation was done from batch data and from continuous operation by a method described here. Although it was less tedious to obtain substrate consumption rate versus substrate concentration curves from batch experiments, the data obtained by the continuous method was more reliable for predicting the operation of treatment plants. The method of planning employing the present model is illustrated with an activated sludge treatment plant for the dairy industry with the following parameters: influent chemical oxygen demand, 1,780 mg/cu dm; influent anionactive detergent (n-dodecylbenzene sulfonic acid) concentration, 130 mg/cu dm; and influent flow rate, 1,000 cu m/day. (Rochester-PTT)
W87-01002

EVALUATION OF AN AERATOR CONTROL STRATEGY UTILIZING TIME VARYING MATHEMATICAL MODEL SIMULATIONS,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Medford, MA.
D. A. Barton, and J. J. McKeown.
Water Science and Technology WSTED4, Vol. 18, No. 6, p 189-201, 1986. 4 fig, 3 tab, 5 ref.

Descriptors: *Aerators, *Process control, *Stabilization lagoons, *Pulp and paper industry, *Energy, *Mathematical models, *Wastewater treatment facilities, Organic loading, Simulation, Time-varying models.

A mechanistic mathematical model of the aerated stabilization basin process utilized in the pulp and paper industry is presented. The time-variable model is calibrated for a paper mill wastewater treatment system and is used to develop and test a control scheme for the optimization of aeration intensity. The control scheme is shown to reduce aerator usage on an annual basis by 17-30% compared to the case of no control. The aerator usage reduction percentage was inversely related to the organic loading rate per aerator horsepower. Savings in aerator usage under the control scheme were equivalent to the existing practice of seasonal aeration control. Modest improvements in effluent quality were observed under the control scheme. (Author's abstract)
W87-01003

INDUSTRIAL USE OF REVERSE OSMOSIS,
Camp, Dresser and McKee, Inc., Boston, MA.
P. D. Sinisgalli, and J. L. McNutt.
American Water Works Association Journal, JAWWA5, Vol. 78, No. 5, p 47-51, May 1986. 3 fig, 7 ref.

Descriptors: *Reverse osmosis, *Wastewater treatment, *Water treatment, Filtration, Microelectronica, Semiconductors, Design, Demineralization, Brine recovery.

Reverse osmosis (RO) as a water treatment process in private industry has dramatically increased over the past five years due to increased product quality and membrane system performance. Design of RO systems must include a thorough examination of each unit process to determine the effect on other units. Properly designed RO systems provide effective industrial wastewater treatment, waste management, and recycling - all of which produce higher quality product water at a reasonable cost. (Main-PTT)
W87-01020

C-390 AS SOLE SELECTIVE AGENT FOR ISOLATION OF PSEUDOMONAS AERUGINOSA FROM HOSPITAL WASTE WATER,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, and M. During.
Canadian Journal of Microbiology CJBOAW, Vol. 32, No. 6, p 513-515, June 1986. 2 tab, 14 ref. Directorate General of Environmental Protection, Ministry of Housing, Physical Planning and Environment (Netherlands) Project RIVM 218202.

Descriptors: *Pseudomonas aeruginosa, *Hospital wastewater, *Differential media, *Bacterial analysis, *C-390, Casein hydrolysis, Pyoverdin, 9-Chloro-9-(4-dimethylaminophenyl)-10-phenylacridan.

Pseudomonas aeruginosa was recovered (in numbers ranging from 100-10,000 colony-forming units per ml) from heavily contaminated hospital waste water when grown at 41.5 C on a differential medium agar containing 9-chloro-9-(4-dimethylaminophenyl)-10-phenylacridan (C-390) at a final concentration of 30 microgram/ml. The medium appeared to be highly selective for P. aeruginosa isolated from hospital waste waters. Many strains failed to hydrolyze casein when grown on skim milk agar and this medium appeared to restrict pigment production to only pyoverdin (detectable only under ultraviolet light). Most strains were capable of casein hydrolysis when grown on a modified skim milk medium. (Author's abstract)
W87-01039

CONCENTRATION AND REMOVAL EFFICIENCY OF MAJOR AND TRACE ELEMENTS IN MUNICIPAL WASTEWATER,
Morehouse School of Medicine, Atlanta, GA. Dept. of Community Health/Preventive Medicine.
J. P. C. Sung, A. E. Nevissi, and F. B. Dewalle.
Journal of Environmental Science and Health (A) JESEDU, Vol. 21, No. 5, p 435-448, July 1986. 4 tab, 10 ref. EPA Contract R-806102.

Descriptors: *Wastewater treatment, *Trace elements, *Treated water, *Raw wastewater, *Primary wastewater treatment, *Secondary wastewater treatment, *Sewage disposal, *Primary sludge, *Secondary sludge, *Urban areas, Evaluation, Wastewater treatment, Phosphorus, Iron, Zinc, Copper, Manganese, Chromium, Lead, Nickel, Silver, Cadmium, Arsenic, Cobalt, Mercury, Selenium.

Concentrations of 14 elements in raw sewage, primary effluent, secondary effluent, discharge, primary sludge, and secondary sludge were measured in wastewater samples from treatment systems of 25 different metropolitan areas in the US, and the efficiency of removal of these elements from raw sewage was calculated. The elements P, Fe, Zn, Cu, Mn, Cr, Pb, Ni, Ag, Cd, As, Co, Hg, and Se were present in raw sewage, in descending order of mean and median values of concentration. A similar concentration hierarchy, with few exceptions, was observed in effluents and sludges. The frequency and percentage of element removal from raw sewage in treatment plant were calculated. According to these calculations, Pb was removed from discharge in 90% of the plants at least 50% relative to raw sewage. The removal order (in terms of plants achieving at least 50% removal) was Zn, Fe, Cr, Cd, Cu, P, Ag, Ni, Mn, and Co. (Rochester-PTT)
W87-01044

PUTTING WASTEWATER TO WORK,
Howard, Needles, Tammen and Bergendoff, Orlando, FL.
For primary bibliographic entry see Field 3C.
W87-01047

TUNNEL THAT CLEANED UP CHICAGO,
R. Robinson.
Civil Engineering, Vol. 56, No. 7, p 34-37, July 1986. 2 fig.

Descriptors: *Water pollution control, *Tunnel and Reservoir Plan, *Storm-overflow sewers, *Chicago, *Engineering, Cost analysis, Tunneling.

The metropolitan Chicago Tunnel and Reservoir Plan (TARP) is described, including the planning, costs, pumping station, and mention of important consultants, engineers and contractors. TARP is intended to store water and sewage that would normally spill into waterways, yards, and basements in Chicago during heavy rains, and to release it to treatment plants at a rate that they can handle. The Mainstream portion of the tunnel cost 975 million dollars and received the Outstanding Engineering Achievement Award of 1986. In the first year of operation TARP has eliminated 80% of the combined sewage pollution problems throughout most of Chicago and 15 nearby suburbs, a 204 sq mi area. Construction advanced the art and science of boring through rock deep under urban areas. (Rochester-PTT)
W87-01048

COMPARISON OF METHODS FOR THE PREPARATION OF SEWAGE SLUDGE SAMPLES PRIOR TO SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHORUS,
Rutgers - The State Univ., Camden, NJ.
For primary bibliographic entry see Field 5A.
W87-01092

MODELING OF SMALL SCALE REVERSE OSMOSIS SYSTEMS,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3A.
W87-01103

DESIGN STRATEGIES FOR NUTRIENT REMOVAL PLANT,
Meiring and Partners, Pretoria (South Africa).
J. L. Barnard, G. M. Stevens, and P. J. Leslie.
Water Science and Technology WSTED4, Vol. 17, No. 11/12, p 233-242, 1985. 3 fig, 1 tab, 8 ref.

Descriptors: *Biological wastewater treatment, *Wastewater facilities, *Wastewater treatment, *Canada, *Cold regions, *Nitrates, *Phosphates, *Design criteria, Nitrification, Denitrification, Temperature effects, Effluents, Anaerobic conditions, Sludge conditioning.

Design strategies and results for nitrate and phosphate removal at a one stage wastewater treatment plant in a cold climate (Kelowna, British Columbia, Canada) are reviewed. Design criteria, treatement requirements and the models used to establish nitrification and denitrification rates are discussed. Plant performance in terms of design assumptions is analyzed. It is concluded that there are several inadequacies with previous models that predicted only the UCT variation of the Phoredox process could be used to achieve satisfactory rates of phosphate removal. The study indiciates the possibilities of designing with confidence for removal of nitrates and phosphates at treatment plants in the colder climates of the world. (Michael-PTT)
W87-01121

FULL SCALE OPTIMIZATION OF BIOLOGICAL PHOSPHORUS REMOVAL AT KELOWNA, CANADA,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
W. K. Oldham.
Water and Science Technology WSTED4, Vol. 17, No. 11/12, p 243-257, 1985. 14 fig, 3 tab, 12 ref.

Descriptors: *Biological wastewater treatment, *Sludge conditioning, *Wastewater treatment, *Wastewater facilities, *Canada, *Phosphorus removal, *Anaerobic conditions, Effluents, Nitrogen, Denitrification, Fermentation, Anaerobic digestion, Sludge thickening, Orthophosphates.

Operational results and optimization tests conducted at a new biological nutrient removal facility operating in the Phoredox mode at Kelowna, Canada for 1983 are reviewed. The effects on plant efficiency of varying the point of introduction of return sludge flow and addition of primary sludge thickener supernatant to the bioreactor were evaluated. There was no significant difference in effluent nutrient quality between tests with all return sludge entering the anaerobic zone or with half entering the anaerobic zone and half entering the anoxic zone. Primary sludge thickener supernatant added to the anaerobic zone typically resulted in an effluent phosphorus concentration of less that 0.1 milligram of orthophosphate per liter while the absence of supernatant resulted in an effluent containing more than 2 milligrams of orthophosphate per liter. (Michael-PTT)
W87-01122

OXIDATION REDUCTION POTENTIAL - A TOOL FOR MONITORING, CONTROL AND OPTIMIZATION OF BIOLOGICAL NUTRIENT REMOVAL SYSTEMS,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
F. A. Koch, and W. K. Oldham.
Water Science and Technology WSTED4, Vol. 17, No. 11/12, p 259-281, 1985. 11 fig, 1 tab, 40 ref.

Descriptors: *Biological wastewater treatment, *Biological oxidation, *Wastewater treatment, *Monitoring, *Process control, *Automation, *Measuring instruments, Nitrogen, Phosphorus, Anaerobic digestion, Electrodes, Voltmeters, Nitrates, Dissolved oxygen, Sludge conditioning, Pilot plants, Sensors.

Results of a three-year investigation indicate that oxidation-reduction potential (ORP) monitoring can provide a meaningful indication of process and bioreactor performance in biological nutrient removal systems. ORP determinations can be used to distinguish between different levels of respiratory activity and identify the onset of non-respiratory conditions. This capability can provide a rational basis for real-time control and optimization of process nitrogen removal. ORP is also found to correlate with observed phosphorus release. It is concluded that ORP is a useful tool for process monitoring, control and optimization, particularly

as a sensor for continuous process monitoring and automated process control. (Michael-PTT)
W87-01123

PEAT ADSORPTION OF HERBICIDE 2,4-D FROM WASTEWATERS,
Laval Univ., Quebec. Dept. de Genie Chimique.
J. N. Clouthier, A. Leduy, and R. S. Ramalho.
Canadian Journal of Chemical Engineering, Vol. 63, No. 2, p 250-257, April 1985. 13 fig, 4 tab, 16 ref.

Descriptors: *Adsorption, *Peat, *Herbicides, *2,4-D, *Contamination, *Wastewater treatment, *Wastewater, Hydrogen ion concentration, Particle size, Temperature effects, Mathematical equations, Equilibrium, Wastewater facilities, Design criteria.

The use of peat as an adsorbent for removal of the herbicide 2,4-D (dichloro-phenoxy acetic acid) from wastewater was evaluated. The effect of the initial 2,4-D concentration, pH, peat particle size, temperature and concentration of peat on the time required to reach adsorption equilibrium and on the mass of 2,4-D adsorbed at equilibrium conditions was examined. Removal ratios for the 2,4-D on the order of 90 percent were obtained under optimum conditions. Continuous tests in the adsorption column system were also conducted to determine design parameters for a proposed treatment plant. (Michael-PTT)
W87-01124

REMOVING TRACE ORGANICS BY REVERSE OSMOSIS USING CELLULOSE ACETATE AND POLYAMIDE MEMBRANES,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-01132

COMPETITIVE ADSORPTION AMONG VOCS ON ACTIVATED CARBON AND CARBONACEOUS RESIN,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. J. Kong, and F. A. DiGiano.
American Water Works Association Journal JAWWA5, Vol. 78, No. 4, p 181-188, April 1986. 11 fig, 5 tab, 14 ref.

Descriptors: *Adsorption, *Organic compounds, *Volatility, *Activated carbon, *Resins, *Carbon filters, Carbon tetrachloride, Trichloroethylene, Tetrachloroethylene, Mathematical models, Adsorbents, Groundwater, Mathematical equations, Isotherms.

An ideal adsorbed solution (IAS) model was used to predict multicomponent adsorption equilibria for carbon tetrachloride, trichloroethylene and tetrachloroethylene in two- and three-component solutions on activated carbon and carbonaceous resin. Experiments were performed to acquire isotherm parameters and verify model results. The model described some, but not all, of the competitive adsorption equilibrium data among the volatile organic chemicals (VOCs). Cabonaceous resin has a higher capacity for each of the three VOCs than activated carbon. The order of adsorbability in competition agrees with that expected from the relative adsorbability of each VOC as determined from its adsorption isotherms. Given equal concentrations of each VOC, resin dosage is from three to five times smaller than that of activated carbon needed to reach a desired residual concentration. This demonstrates the advantage of resin over activated carbon more clearly than does a comparison of single-solute adsorption behavior. (Author's abstract)
W87-01134

EFFECTS OF LOW TEMPERATURE ON THE REMOVAL OF TRIHALOMETHANE PRECURSORS BY COAGULATION,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. R. Knocke, S. West, and R. C. Hoehn.
American Water Works Association Journal JAWWA5, Vol. 78, No. 4, p 189-195, April 1986. 16 fig, 2 tab, 15 ref.

Descriptors: *Temperature effects, *Trihalomethane, *Coagulation, Organic carbon, Color removal, Hydrogen ion concentration, Organic compounds, Seasonal variation, Water treatment, Water temperature.

Trihalomethane (THM) concentration in finished water that had been treated at 35.6 F was significantly lower than that in water treated at 71.6 F. Total organic carbon (TOC) was not affected by water temperature during coagulation with metal ion salts, while color removal was slightly reduced at lower temperatures. The efficiency of coagulation for removing TOC and color and reducing THM formation potential was improved when water was treated at lower pH regardless of temperature. Removal of low-molecular-weight organic substances was found to be more difficult at lower temperature. The data suggest that reduced THM concentration in finished water during winter is strictly a function of the reduced rate of THM formation. (Author's abstract)
W87-01135

SAUSALITO WASTEWATER SQUEEZE,
M. Ralston.
Engineering News Record, Vol. 216, No. 6, p 46-47, April 17, 1986.

Descriptors: *Wastewater treatment facilities, *Sausalito, *California, Construction methods, *Site selection, *Design criteria.

Design constraints and construction problems associated with development of a new secondary wastewater treatment facility in Sausalito, CA are reported. (Michael-PTT)
W87-01136

COTTON FABRIC DESIZING AND SCOURING WASTEWATER TREATMENT IN UPFLOW ANAEROBIC FILTER,
Patras Univ. (Greece). Dept. of Chemistry.
N. Athanasopoulos.
Biotechnology Letters BILED3, Vol. 8, No. 5, p 377-378, May 1986. 4 ref.

Descriptors: *Anaerobic digestion, *Filtration, *Wastewater treatment, *Filters, *Cotton, Cost analysis, Textile mill wastes, Textiles.

Cotton and cotton blend fabric plants produce high volumes of wastewater relatively low in organic load. The usual method of wastewater treatment is a combination of an aerobic and chemical system; the operating cost of such treatment is very high due to energy requirements and the cost of nutrient chemicals and sludge treatment and disposal. In this experiment, wastewater from textile desizing and scouring was successfully treated in an upflow anaerobic filter at 35 C; the chemical oxygen demand (COD) loading was gradually increased up to 2.75 kg per cu m per day with COD removal of 60-90%, and production of 0.2-0.5 L gas/g influent COD, having 75-80% CH4. By treating the warm wastewater stream coming from desizing and scouring processes by anaerobic filters, the total treatment cost is drastically reduced. (Doris-PTT)
W87-01162

STABILITY OF A PERCOLATING ANAEROBIC DOWNFLOW FIXED FILM REACTOR UNDER OVERLOADING CONDITIONS,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
M. Canovas-Diaz, and J. A. Howell.
Biotechnology Letters BILED3, Vol. 8, No. 5, p 379-384, May 1986. 3 fig, 1 tab, 19 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Biological treatment, *Downflow fixed-film reactor, Food-processing wastes, Industrial wastes, Biological wastewater treatment.

An anaerobic downflow fixed film (DSFF) reactor was used to treat cheese whey. The reactor was initially operated flooded (DSFF mode) and then the liquid level reduced by 67% (ATF mode); thus, the packing support was completely submerged and one third submerged, respectively. The partly submerged anaerobic culture had higher gas production and was more resistant to general and localized high VFA levels. Methanogenic bacteria were acclimated to VFA levels as high as 3,000 mg/l of propionate and 1,600 mg/l of acetate (pH near neutrality) while the reactor remained stable. (Author's abstract)
W87-01163

GRANULATION OF BIOMASS IN THERMOPHILIC UPFLOW ANAEROBIC SLUDGE BLANKET REACTORS TREATING ACIDIFIED WASTEWATERS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
W. M. Wiegant, and A. W. A. de Man.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 5, p 718-727, May 1986. 5 fig, 3 tab, 20 ref.

Descriptors: *Thermophilic bacteria, *Wastewater treatment, *Anaerobic digestion, *Upflow sludge blanket reactor, Biological treatment, Acidic water.

The development of granular sludge was investigated in thermophilic (55 C) upflow anaerobic sludge blanket reactors. Acetate and a mixture of acetate and butyrate were used as substrates, serving as models for acidified wastewaters. Granular sludge with either Methanothrix or Methanosarcina as the predominant acetate-utilizing methanogen was cultivated by allowing the loading rate to increase whenever the acetate concentration in the effluent dropped below 200 and 700 mg COD/L, respectively. The highest methane generation rates (up to 162 kg CH4-COD per cu m per day, or 2.53 mole CH4/L per day) were achieved at hydraulic retention times down to 21 min, with granules consisting of Methanothrix. The formation of Methanothrix granules did not depend on the type of seed material, nor on the addition of inert support particles. The growth of granules proceeded rapidly with adapted seed material, even when the reactors were inoculated with low concentrations. With mesophilic seed materials, growth of granules took much longer. Thermophilic Methanothrix granules strongly resemble mesophilic granules of the 'filamentous' type. Some factors governing the thermophilic granulation process are discussed. (Author's abstract)
W87-01164

COMPARISON OF COMPOSTING OF TWO SEWAGE SLUDGES,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Nakasaki, M. Shoda, and H. Kubota.
Journal of Fermentation Technology JFTED8, Vol.63, No.6, p 537-543, 1985. 6 fig, 4 tab, 7 ref.

Descriptors: *Sludge composting, *Sewage sludge, *Compost, Composting, Wastewater, Wastewater treatment, Sludge cake, Sludge dewatering, Sludge drying.

Dewatered sewage sludge cake is one of the organic materials available for composting in Japan. A mixture of raw and excess sewage sludge is dewatered by the addition of two kinds of dewatering agent. One is a mixture of slaked lime and ferric chloride, the other a polymer coagulant. The sludge containing the inorganic coagulant is denoted as lime sludge, the other as polymer sludge. An analytical procedure has been developed to represent the rate of degradation of organic matter in composting of lime sludge as CO2 evolution rate, and showed the microbial contribution to the rate. Comparison was made of the reaction rate and microbial succession in the composting of sewage sludges which contained lime or polymer as dewatering agents. Different patterns of CO2 evolution rate based on dry solid of compost were observed, which was explained by the difference in the initial pH values of the two sludges. No significant differences of CO2 evolution rate based on volatile matter of sludge was observed in the region where

pH reached around 8 and temperature was 60 C. Dominant species of isolated thermophilic bacteria and thermophilic actinomycetes were more varied in the polymer sludge than the lime sludge. Specific O2 uptake rate of isolated thermophilic bacteria from the polymer and lime sludges were similar. Addition of lime to the polymer sludge decreased the survival number of indigenous microorganisms. (Khumbatta-PTT)
W87-01188

METHYL CHLORIDE: NATURALLY OCCURRING TOXICANT AND C-1 GROWTH SUBSTRATE,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Mikrobiologisches.
S. Hartmans, A. Schmuckle, A. M. Cook, and T. Leisinger.
Journal of General Microbiology JGMIAN, Vol. 132, No. 4, p 1139-1142, April 1986. 2 fig, 18 ref.

Descriptors: *Wastewater treatment, *Methyl chloride, *Chlorinated hydrocarbons, Organic compounds, Sewage bacteria, Bacteria, Biodegradation, Degradation.

A strain of Hyphomicrobium which could utilize methyl chloride as its sole carbon and energy source was isolated from industrial sewage plants. This methylotroph used methyl chloride quantitatively, liberating chloride ion stoichiometrically. A specific growth rate of 0.09 per hour was observed with 1% (v/v) methyl chloride in the gas phase. (Author's abstract)
W87-01241

DETECTION AND ENUMERATION OF LISTERIA MONOCYTOGENES IN A SEWAGE TREATMENT PLANT IN IRAQ,
Biological Research Center, Baghdad (Iraq).
For primary bibliographic entry see Field 5B.
W87-01251

MUSHROOM BLANCH WATER CONCENTRATION BY MEMBRANE PROCESSES,
National Taiwan Univ., Taipei. Graduate Inst. of Food Science and Technology.
B. H. Chiang, C. L. Chu, and L. S. Hwang.
Journal of Food Science, Vol. 51, No. 3, p 608-613, April 1986. 11 fig, 5 tab, 24 ref. National Science Council (Taiwan) Project NSC 73-0406-E002-01.

Descriptors: *Wastewater treatment, *Food processing industry, *Membrane processes, Ultrafiltration, Reverse osmosis, Mushroom blanch water, Organic matter.

Mushroom blanch water was concentrated by ultrafiltration (UF) and reverse osmosis (RO). UF prefiltration was essential in preventing severe fouling during the RO process. When the UP blanch water permeate was processed by RO, linear relationships between pressure and flux were observed at all concentrations tested. The blanch water was concentrated by UF/RO from 2% to 13% total solids at 60 C and 120 KPa/5000 KPa operating pressures with flux higher than 15 liters/sq m/hr. Maximum concentration obtained was approximately 20% total solids with 90% recovery of the nonvolatiles. Recoveries of some major volatiles were above 50%. Panelists could not differentiate the original from the reconstituted blanch waters in sensory evaluations. (Author's abstract)
W87-01272

PRESS GANG CURES SLUDGE OVERLOAD PROBLEM,
Richardson (Edward H.) Associates, Inc., Newark, DE.
K. C. Goel.
Engineering and Management WENMD2, Vol. 133, No. 2, p 25-27, February 1986. 2 tab.

Descriptors: *Press gang, *Wastewater treatment, *Sludge drying, *Filter belts, Economics, Dewatered sludge, Sludge Disposal, Sewage, Performance evaluation, Delaware.

Sludge management at Wilmington, Delaware is being effectively accomplished by a gang of 14 filter belt presses. The system dewaters sludge with continuous belt filter presses and uses polymer as the sludge conditioner. With this sludge dewatering installation augmenting its wastewater treatment facilities, the city of Wilmington's sludge management needs are well met for the foreseable future. (Main-PTT)
W87-01411

SEWER REHAB USING A NEW SUBAREA METHOD,
RJN Environmental Associates, Inc., College Park, MD.
R. B. Fernandez.
Engineering and Management WENMD2, Vol 133, No. 2, p 28-30, February 1986. 1 fig, 6 tab, 1 ref.

Descriptors: *Sewer rehabilitation, *Groundwater infiltration, *Storm water inflow, *Infiltration migration, *Wastewater collection, Washington Suburban Sanitary Commission, Flow rates, Rainfall monitoring, Smoke testing, Point-source rehabilitation, Mathematical models.

In the effort to understand and resolve the problems of groundwater infiltration and storm water inflow, many sewer rehabilitation programs have demonstrated a disparity between anticipated and actual reduction of infiltration/inflow (I/I). Some of the causes are unidentified defects; inaccurate defect flow rates; insufficient rehabilitation design; inflexible rehabilitation plan; unreliable flow data; and infiltration migration. An extensive project was undertaken at two sites in the Washington Suburban Sanitary Commission service area to study migration. Analysis of the field data yeilded a calibrated infiltration migration model. A new approach to sewer system evaluation and rehabilitation referred to as the Systems Approach to Subarea Rehabilitation (SASR) was developed. Field activities incorporated in the SASR are: rainfall monitoring; continuous flow monitoring; internal night-time flow measurements; manhole and visual pipe inspection; smoke testing; dyed water flooding; television inspection; and building inspection. Further refinements are planned. It will be possible to extend the quantification process and the model will be computerized and further refined with new data. (Main-PTT)
W87-01412

INSTRUMENTATION COORDINATOR FOCUSES CONSTRUCTION TEAM EFFORT,
Indianapolis Public Works Dept., IN.
M. W. Sweeney, and C. N. Williams.
Engineering and Management WENMD2, Vol. 133, No. 2, p 31-33, February 1986. 2 fig.

Descriptors: *Wastewater treatment, *Process control, *Construction team, Treatment facility personnel, Treatment facility construction, Computer contol, Instrumentation.

In Indianapolis, Indiana an entire advance wastewater treatment (ATW) project involved a 6-member design team. An I&C (Instrumentation and Control) Cordinator provided the focus of responsibility within the multiple-member team of owner, design engineers, contractors and equipment vendors to ensure successful installation and operation of the MCS (Main Control System). The major responsiblity of the assignment was to ensure proper installation of the instrumentation prior to and during start up. The I&C Coordinator had to have a blend of managerial and technical skills. The I&C Coordinator successfully led this team through the maze of information and events needed to make the MCS work. (Main-PTT)
W87-01413

INDICATOR VALUE OF THE GENUS EPISTYLIS (CILIATA),
Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
V. Sladecek.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 1, p 119-124, July 1986. 1 fig, 1 tab, 19 ref.

Descriptors: *Bioindicators, *Epistylis, *Limnology, *Wastewater treatment, *Classification, Saprophytic bacteria, Activated sludge, Stabilization ponds, Biofilters.

The genus of peritrichous ciliates Epistylis plays an important role in applied limnology, as it forms a substantial part of the communities of biofilters, activated sludge and stabilization ponds, where the purification of organic waste waters is performed. The sessile genus can be easily recognized according to the firm, non-contractile stalk, which is dichotomously branched and supports a colony of zoids comprised of 2 to several tens of individuals. The adoral zone has about one turn of cilia. There are approximately 100 species belonging to this genus, and the majority live epibiotically on various freshwater plants, insects and arthropods. Fifteen species of the infusorian genus Epistylis were reviewed and classified saprobiologically. They were given the saprobic valence, the indicative weight of species (I sub i) and the individual saprobic index (S sub i). Diagnoses of 3 species were translated into English from Russian and a serious error dealing with incorrect identification of Epistylis rotans instead E. ureolata in the activated sludge was clarified. (Lantz-PTT)
W87-01460

ACTIVATED SLUDGE PROCESS - IV: APPLICATION OF THE GENERAL KINETIC MODEL TO ANOXIC-AEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE,
Geustyn, Forsyth and Jouber, Inc., Stellenbosch (South Africa).
A. P. C. Warner, G. A. Ekama, and G. V. R. Marais.
Water Research WATRAG, Vol. 20, No. 8, p 943-958, August 1986. 7 fig, 2 tab, 18 ref.

Descriptors: *Activated sludge, *Kinetics, *Model studies, *Aerobic digestion, *Wastewater treatment, Sludge digestion, Digestion, Simulation analysis, Mathematical models.

A general activated sludge model was applied to anoxic-aerobic digestion of waste activated sludge. The laboratory scale experimental investigation comprised a 6 day sludge age activated sludge process, the waste sludge from which was fed to a number of digesters operated as follows: single reactor flow-through digesters at 4 or 10 days sludge age (retention times) under aerobic or anoxic-aerobic conditions (with 1.5 and 4 h cycle times), and 3-in-series flow-through digesters each with 4 days sludge age. All digesters were fed draw-and-fill wise once per day. The general kinetic model simulated accurately all the experimental data without the need to change the values of the kinetic constants. Both theoretical simulations and experimental data indicate that (i) the rate of volatile solids destruction is not affected by the incorporation of anoxic cycles, and (ii) the specific denitrification rate constant in a digester is about two-thirds of that in the secondary anoxic reactor of the single sludge activated sludge system. This allows for definition of a fourth denitrification rate constant K sub 4, for the anoxic-aerobic digester with K sub 4T = 0.046(1.029 to the (t-20) power mg(NO3-N)/(mgAVSS d), a constant independent of sludge age. An important consequence of (i) and (ii) above is that the denitrification can be integrated readily into steady state digester models, and used for design purposes. (Author's abstract)
W87-01462

PH-DECREASE IN NITRIFYING BIOFILMS,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
H. Szwerinski, E. Arvin, and P. Harremoes.
Water Research WATRAG, Vol. 20, No. 8, p 971-976, August 1986. 7 fig, 2 tab, 22 ref.

Descriptors: *Hydrogen ion concentration, *Nitrification, *Biofilms, *Wastewater treatment, Acidity, Theoretical analysis.

Nitrification is an acidity producing process. The theoretical model predicts the pH-effect to initiate and climax at a HCO3(-)/O2 molar ratio in the bulk water from 10 to 2.4. The molar ratio found

experimentally was in the range 6.0-0.9. These theoretical results have been verified on biofilms developed on the surfaces of a rotating drum under well controlled laboratory conditions. The results show clearly the drop in pH as predicted by theory. The phenomenon can give rise to unexpected effects on the performance of nitrifying biofilms, when most of the bacteria work under a much lower pH than the pH measured in the bulk water. (Lantz-PTT)
W87-01465

PHOSPHORUS REMOVAL BY GRANULAR ACTIVATED ALUMINA,
Reinertsen (A.R.) Consulting Engineers, Trondheim (Norway).
H. Brattebo, and H. Odegaard.
Water Research WATRAG, Vol. 20, No. 8, p 977-986, August 1986. 6 fig, 1 tab, 40 ref.

Descriptors: *Phosphorus removal, *Activated alumina, *Wastewater treatment, Adsorption, Model studies, Diffusion, Sensitivity analysis, Hydrogen ion concentration, Particle size.

Phosphorus removal from wastewater may be carried out by fixed-bed adsorption using activated alumina. In order to prevent unacceptable headlosses coarse-grained alumina must be used. Such systems have been referred to by several authors in literature. The mass transport characteristics of the system has so far, however, not been given a thorough investigation. This study uses the homogeneous surface diffusion model (HSDM) to describe the process as influenced by the system parameters. A sensitivity analysis is presented to optimize the process design for given conditions. The pH, the alumina particle size and the column length are found to be very important parameters determining the column performance. The process is very well suited for designing a beds-in-series system. (Author's abstract)
W87-01466

VIRUS RECOVERY FROM WASTEWATER TREATMENT PLANT SLUDGES,
Nancy-1 Univ. (France). Faculte des Sciences Pharmaceutiques et Biologiques.
For primary bibliographic entry see Field 5A.
W87-01470

EFFLUENT DENITRIFICATION WITH ANAEROBIC FILTERS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert and, and H. S. Park.
Water Research WATRAG, Vol. 20, No. 8, p 1015-1021, August 1986. 3 fig, 4 tab, 17 ref.

Descriptors: *Denitrification, *Effluents, *Wastewater treatment, *Filtration, Anaerobic conditions, Nitrates, Nitrites, Tropical regions.

Experiments with two pilot-scale anaerobic filters were conducted to investigate their efficiencies in denitrifying a wastewater effluent under ambient, tropical conditions. The pilot-scale anaerobic filters could effectively denitrify a wide range of influent nitrate concentrations from 19.8 to 409.3 mg/L (corresponding to the nitrate and nitrite loadings of 53.1-549.7 g/cu m/d). Between 89 and 98% denitrification was achieved and a straight-line relationship between the nitrate and nitrite loadings vs the denitrification rates was observed. The specific surface areas of the filter medium did not exhibit any significant effects on the denitrification cation efficiency. There were no clogging nor solids buoy-up problems during the 8-month operation period. Nitrite accumulation could possibly occur in the anaerobic filters denitrifying the influents high in nitrate concentrations, causing the effluent nitrite concentrations to be higher than the effluent nitrte concentrations. (Lantz-PTT)
W87-01471

MINERALIZATION OF ORGANIC MATTER AND OTHER CHEMICAL EFFECTS OF CHLORINATION,
Maryland Univ., College Park. Dept. of Chemistry.
D. A. Dotson, G. R. Helz, and R. Sugam.
Water Research WATRAG, Vol. 20, No. 8, p 1031-1039, August 1986. 6 fig, 2 tab, 21 ref.

Descriptors: *Mineralization, *Organic matter, *Chlorination, *Water treatment, Rivers, Estuaries, Chlorine, Carbon dioxide, Ammonia, Nitrates, Oxidation, Monochloramine, Wastewater treatment.

Selected river waters, estuarine waters and effluents from wastewater treatment plants, collected during various seasons, were treated with 0.14 mM (10 ppm) chlorine to determine the reactive components involved in chlorine decay reactions. Mineralization of organic matter, detected by measuring evolved CO_2, was universal and constituted the most significant decay process observed. In most cases, loss of ammonia, primary organic amines and nitrite occurred, but removal of these components was not complete. Nitrate was usually produced, but the increases were small relative to initial concentrations. Ammonia in secondary effluent retards chlorine decay and suppresses carbon mineralization. After a week, renewed microbial growth began in anaerobic river water treated with monochloramine even though residual monochloramine remained. The onset of growth coincided with accelerated decay of the monochloramine residual, suggesting that reducing agents were being produced biologically. The faster decay of residual chlorine in denitrified secondary effluents, with low ammonia, demonstrates an additional environmental benefit of denitrification. (Author's abstract)
W87-01473

POWER ECONOMY CHARACTERISTICS OF AN ACTIVATED SLUDGE AERATION TANK,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Fujie, and H. Kubota.
Water Research WATRAG, Vol. 20, No. 8, p 1051-1058, August 1986. 7 fig, 1 tab, 14 ref.

Descriptors: *Power economy characteristics, *Activated sludge process, *Aeration, *Wastewater treatment, Activated sludge, Biological oxygen demand, Oxygen, Mathematical analysis, Air blower, Mathematical models, Japan, Effluents, Water quality.

The air feed rate to meet a given oxygen uptake rate in an activated sludge aeration tank was expressed by using the concept of the air diffuser performance. Using the relationship between the BOD removal and the oxygen uptake rate, a procedure to predict the power economy, which is defined as the amount of BOD removed per unit power consumption of the air feeding, and the effluent quality of the activated sludge process under various operating conditions was presented. The effect of operating parameters in the tank, the mixed liquor suspended solids concentration, the hydraulic retention time, and the BOD loading on the power economy and the effluent quality, were extensively evaluated. The power economy characteristics of the activated sludge process predicted by the proposed mathematical model were successfully compared with the operating data obtained in municipal wastewater treatment plants in Japan. The results calculated by the model indicate that the efficiency of the air blower is a significant factor controlling the power economy of the aeration tank, and an adequate selection and operation of the air blower are essential to yield high power economy. The power economy was also strongly affected by the oxygen demands of the nitrification and the endogenous respiration of the activated sludge. The removal of suspended solids from the effluent by an additional device would be effective in improving effluent quality, while maintaining a high power economy. (Lantz-PTT)
W87-01476

ANAEROBIC REACTORS TREATING BEET SUGAR EFFLUENTS,
Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
B. Z. Wang, J. Sui, R. F. Liu, G. Yang, and P. S. Qi.
Effluent and Water Treatment Journal EWTJAG, Vol. 26, No. 5/6, p 150-151, 154-162, May 1986. 23 fig, 6 tab, 12 ref.

Descriptors: *Anarerobic reactors, *Wastewater treatment, *Beet sugar, *Effluents, China, Wastewater.

The Heilongjiang Province in the Northeast of China has a large number of beet sugar mills, thereby resulting in the production of large quantities of high strength organic wastewater which is discharged into the nearby receiving water courses from those mills during every production period, thus causing heavy pollution to the water systems, with fish death incidents often occuring due to over consumption of dissolved oxygen by this kind of wastewater. Therefore, it is imperative to treat this kind of wastewater effectively and efficiently before discharge to receiving waters. Unfortunately, the existing beet sugar mills lack wastewater treatment facilities. Furthermore, some studies have shown that aerobic biological treatmeat of high strength organic wastewaters including beet sugar mill effluents is technically feasible but economically unacceptable because of high capital and operational costs and high energy consumption. Anaerobic treatment with its many merits, such as high loadings, low solid production, low nutrient requirement, and biogas production, enables the process to generate or recover energy as an energy source instead of only energy saving, by means of which its operational cost can be reduced by a big margin, compared with a high energy consmuptive aerobic process. Application of anaerobic biodegradation of organic substances to organic wastewater treatment is feasible from the viewpoints of both thermodynamics and microbiological reaction dynamics. However, in order to put the process into practice, lots of engineering aspects have to be solved in advance. Three types of anaerobic reactors were designed, installed and operated for the purpose of treating beet sugar mill effluent in the study. The experimental study was carried out in three types of upflow anaerobic reactors, i.e. floatstone packed bed AR, sludge packed bed AR and synthetic fibers packed AR. All three types of ARs tested in the study exhibited high efficiences in removing organic substrates from beet mill wastewater during their stable performance. (Khumbatta-PTT)
W87-01513

COMBINED HEAT AND POWER INSTALLATION AT COUNTESS WEAR,
Energy and Waste Systems Ltd., Westbury (England).
J. C. Slack, and R. Entwistle.
Effluent and Water Treatment Journal EWTJAG, Vol. 26, No. 5/6, May/June 1986.

Descriptors: *Gas engines, *Wastewater treatment, *Methane, *Power production, *Digestion plants, Power, Heat, Digester gas.

The largest combined heat and power (CHP) installation of its type in the United Kingdom was successfully completed in December 1985 by Energy and Waste Systems Ltd at the Countess Wear sewage treatment works in Exeter. The plant was built for the South West Water Authority using spark ignition gas engines running on digester gas driving synchronous alternators connected in parallel with the national electricity grid. As a combined heat and power installation the plant contains a number of special features, and these are considered in the light of what has been the normal practice in the use of digester gas up to the early 1980's. The objective of the CHP scheme was to replace existing boilers with engine generators which, in addition to supplying as much of the site power demand as possible, would provide all the heat required by three buildings as well as for the digestion process. During the last five years water authorities have been seeking a more efficient means of utilizing the energy potential resulting from the digestion of sewage sludge. Intially this created a new generation of digestion plants with improved mixing and heating systems, giving increased sludge flows, lower capital costs and better

gas yields. This approach is also being used for the refurbishment of existing digesters with similar results, which has resulted in an increasing number of digestion plants producing an increased amount of gas, being largely methane, with a potential of energy recovery. (Khumbatta-PTT)
W87-01515

PERFORMANCE TESTS ON TERTIARY GRANULAR MEDIA FILTERS,
Northwestern Univ., Evanston, IL. Dept. of Civil Engineering.
J. A. FitzPatrick, and C. L. Swanson.
Effluent and Water Treatment Journal EWTJAG, Vol. 26, No. 5/6, p 179-184, June 1986. 9 fig, 2 tab, 5 ref.

Descriptors: *Tertiary treatment, *Wastewater treatment, *Media filters, *Granular filters, Screens, Sieves, Filtration, Chicago.

The results of full-scale evaluation of 8 small-scale tertiary granular media filtration plants in the Chicago metropolitan area are summarized. The object of which was to characterize filtration plant performance as a function of design and operational variables. All analyses were made on flow proportioned composite samples of secondary effluent (filter influent) and filter effluent. Most sampling periods were 24 hr with occasional periods of 4, 8, 16 hr. Samples were analyzed for turbidity, suspended solids, and 5 day BOD on a routine basis. Flow rate was obtained from plant meters and run lengths were determined from backwash frequency counters. Headloss at the end of runs was determined if filters were equipped with altitude gauges. Performance of tertiary filters is said to be the result of complex interactions between a number of variables. The relatively poor correlations between filter performance and operating parameters can be attributed in part to variations in the characteristics of secondary effluent suspended solids. Such changes can occur on a seasonal or daily basis, or over a shorter time frame during filter runs. For plants where flow to individual filters was varied, average clarification performance decreased linearly with average flow rate. Correlation coefficients between filter solids removal efficiency and operating parameters such as flow, solids loading and run length are poor for data obtained over long time frames. Improved correlations were obtained for data analyzed over shorter time periods which minimized the effect of seasonal and other variations in secondary plant effluent characteristics. Run length did not have a significant effect on plant performance, except for one plant where backwash frequency was varied over a wide range. Differences in characterists of secondary effluent suspended solids rather than media grain size and depth are most likely the major reason for variations in clarification efficiency between plants. (Khumbatta-PTT)
W87-01517

PEROXYGENS IN ENVIRONMENTAL PROTECTION,
Interox Chemicals Ltd., Widnes (England).
J. Fraser.
Effluent and Water Treatment Journal EWTJAG, Vol. 26, Vol. 5/6, p 186-189, June 1986. 19 tab, 39 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Peroxygens, *Peracetic acids, *Environmental protection, *Effluents, Sulphur compounds, Silver, Cyanides, Hydrogen peroxide, Phenols, Metal recovery, Gas scrubbing.

Some of the important properties of hydrogen peroxide which contribute to its suitability for environmental uses include stability for prolonged storage, non-corrosivity, ease of handling, total miscibility with water, strong oxidizing properties and convenience for dosing with readily available equipment. But however, it is unreactive with ammonia and many other organic materials at 'in-use' concentrations. It assists biological oxidation processes and is non-polluting, decomposing to oxygen and water. Its reaction conditions can be controlled for selective oxidation. The most common areas of usage of hydrogen peroxide in industrial effluent treatment are sulphur compounds, phenols, cyanides, metal recovery and gas scrubbing. Hydrogen peroxide is used widely for odor control in sewage, sewage sludges and in the purification of landfill leachates. Important microbial control applications include sterilization of carton materials in aseptic packing, medical uses, and swimming pool cleansing, but hydrogen peroxide is also included in other more powerful industrial sterilants and biocides. The increase in the awareness of need for environmental protection through pollution abatement coupled with the desire for improved hygiene and sanitary conditions highlights major advantages offered by peroxygens, the use of which is increasing worldwide. Unlike many chemicals used throughout industry today certain commercially available peroxygens are fast-acting, non-corrosive, non-bioaccumulatory, with innocuous, safe decomposition products. Their expanding role in improving effluent quality, safeguarding human health and maintaining the standards of many vital products is increasing in attention. This paper concentrates on the broad spectrum of applications of hydrogen peroxide, Interox peracetic acids, and exemplifies these as appropriate with case histories. (Khumbatta-PTT)
W87-01518

TREATING SEWAGE IN ONE TANK,
E. E. Halmos, Jr..
Civil Engineering (ASCE) Vol. 56, No. 4, p 64-65, April 1986. 1 fig.

Descriptors: *Sewage treatment, *Sequencing batch reactors, *Wastewater treatment, Poolesville, Sludge, Wastewater facilities, Wastewater.

Poolesville, Md. had a sewage problem, and a state-imposed moratorium halted further development. The town turned to a sequncing batch reactor in which treatment takes place in just three tanks and an aerobic digester. Using Sequencing Batch Reactor, (SBR) technology, which fitted in with the town's growth and treatment needs and its limited budget. The SBR does not require a heavy, steady flow to be operated at top efficiency, and can handle surges in flow, characteristic of small residential communities. Several other factors which made this method attractive was that all equipment was located in one building or on the adjacent fenced-in property. The Poolesville SBR, though simple in concept and operation, has complex controls and monitoring equipment. The process begins and ends with the idle step in which any one of the three tanks is partially filled with activated sludge. Then, raw sewage is directed to the tank. Aeration begins in this fill process, and is completed during the react step, where microbes act on the sludge. Next, in the settle step, the aerators are shut off, and sludge is allowed to settle to the tank bottom. During the 1 1/2 hour decant process, the clear supernatant is pumped off to pass through pressure filters, ultraviolet disinfection units and post-aeration chambers. Sludge is wasted, as necessary to a two-stage aerobic digester for stabilization. Together, the three tanks handle continuous flows to meet a rated capacity of 625,000 gpd. The town plans to divert excess flows during heavy rains or snowmelt to the old eration lagoon. (Khumbatta-PTT)
W87-01523

FACTORS CONTROLLING THE REMOVAL OF ORGANIC POLLUTANTS IN OZONE REACTORS,
Drexel Univ., Philadelphia, PA. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W87-01540

AEROBIC TREATMENT OF CONCENTRATED WASTEWATER IN A SUBMERGED BED REACTOR,
Universidade Federal do Rio de Janeiro (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia.
L. G. C. Reis, and G. L. Sant'Anna, Jr.
Water Research WATRAG, Vol. 19, No. 11, p 1341-1345, 1985. 6 fig, 3 tab, 9 ref.

Descriptors: *Aerobic treatment, *Wastewater treatment, *Submerged bed reactors, *Biological wastewater treatment, *Performance evaluation, Industrial wastewater, Oxygen demand, Biological treatment, Chemical oxygen demand.

The performance of an aerobic submerged bed reactor was assessed on a concentrated effluent, namely, diluted stillage of alcohol distilleries, presenting a COD content of 3000-3500 mg per liter. The reactor was continuously operated during 200 days, corresponding to five residence times varying from 23 to 4.5 h. The results show that 60-80% of COD removal may be obtained with 10-16 h of residence time. The COD removal efficiency is particularly affected by the liquid retention time, but this influence is less accentuated for periods greater than 16 h. For the two levels of aeration employed in this work, corresponding to U sub G values of 2.1 and 3.9 m per hour, the kinetics was not oxygen-dependent. Additional experiments should be made to determine more judicious operational U sub G values, compatible with mixing and oxygen requirements. The loss in biomass concentration is balanced by the simplicity of reactor operation. Biomass concentrations (volatile solids) in the reactor were approx. 5700 and 500 mg per liter for fixed and suspended forms. These results seem to confirm the capability of the aerobic submerged bed reactor for treatment of concentrated effluents. (Doria-PTT)
W87-01545

EVALUATION OF THE VIRAL POPULATION IN TWO WASTEWATER TREATMENT PLANTS: STUDY OF DIFFERENT SAMPLING TECHNIQUES,
Nancy-1 Univ. (France).
L. Schwartzbrod, P. Vilagines, J. Schwartzbrod, B. Sarrette, and R. Vilagines.
Water Research WATRAG, Vol. 19, No. 11, p 1353-1356, 1985. 6 tab, 16 ref.

Descriptors: *Viruses, *Populations, *Wastewater facilities, *Biological wastewater treatment, *Performance evaluation, Sampling, Enteroviruses, Population dynamics, Public health, Disinfection.

A one-year survey was undertaken on two biological wastewater treatment plants by two different laboratories to gather information on the enteric viral population concentration and on the removal efficiency of the treatment. Different sampling techniques were compared. Results were comparable and showed that enteric viruses were present all year round, their numbers fluctuating randomly within a day. Composite sampling over a period of at least 15 h gave a good representation of the average virus population. (Author's abstract)
W87-01547

MASS TRANSFER MECHANISMS IN A HETEROTROPHIC BIOFILM,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. Siegrist, and W. Gujer.
Water Research WATRAG, Vol. 19, No. 11, p 1369-1378, 1985. 20 fig, 3 tab, 12 ref.

Descriptors: *Mass transfer, *Heterotrophic bacteria, *Biofilms, *Model studies, *Biological treatment, Films, Ions, Water treatment, Diffusion coefficient, Advection, Flow.

The diffusion coefficients of three different chemical species in naturally grown, heterotrophic biofilms were measured and a simple model of mass transfer in a biofilm matrix was developed. The mechanical structure of the biofilm matrix reduces the molecular diffusion to about 50-80% of the value in pure water. Eddy diffusion increased the mass transfer into the biofilm near the surface depending on the roughness of the biofilm surface and the flow conditions. The influence of the diffusion potential and the donnan potential on ions was evaluated by comparing the diffusion coefficients of a positively and a negatively charged ion and a neutral molecule in experiments with different background electrolyte concentrations. Mass trans-

fer effects by electrostatic forces are negligible at the ionic strength of wastewater and tap water. (Author's abstract)
W87-01550

RESPONSES OF CYPERUS INVOLUCRATUS ROTTB. TO NITROGEN AND PHOSPHORUS, WITH REFERENCE TO WASTEWATER RECLAMATION,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
P. J. Hocking.
Water Research WATRAG, Vol. 19, No. 11, p 1379-1386, 1985. 4 fig, 7 tab, 23 ref.

Descriptors: *Cyperus, *Wastewater renovation, *Nitrogen, *Phosphorus, *Performance evaluation, Biological treatment, Aquatic plants, Aquatic life, Wastewater treatment, Nutrient removal.

Cyperus involucratus is a large emergent aquatic plant which may be useful in treating wastewater. Its capacity to take up nitrogen and phosphorus was studied under glasshouse conditions. Maximum growth was attained between 84 and 168 mg NO3-N per liter and 1-5 mg PO4-P per liter. At a low level of supplied NO3-N, most of the N in plant organs was reduced-N; at levels of supplied NO3-N above 84 mg per liter, there was considerable accumulation of NO3-N in plant organs. The accumulation of NO3-N was greatest in culms where it made up more than 50% of their N content when plants were grown on 350 mg NO3-N per liter. More than 60% of the total plant N and P accumulated in above-ground organs, and concentrations of up to 0.53% P and 3.4% N (dry wt basis) were recorded in leaves. C. involucratus would be a suitable plant for wastewater reclamation on account of its high dry matter production, its ability to tolerate hyper-eutrophic levels of N and P, and the accumulation of most of the N and P in the harvestable portions of the plant. (Author's abstract)
W87-01551

EFFECTS OF OZONATION AND ULTRAVIOLET IRRADIATION ON BIODEGRADABILITY OF OIL SHALE WASTEWATER ORGANIC SOLUTES,
California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, R. H. Sakaji, and C. G. Daughton.
Water Research WATRAG, Vol. 19, No. 11, p 1421-1428, 1985. 5 fig, 30 ref. DOE Contract DE-ACO3-76SF00098.

Descriptors: *Biodegradation, *Ozonation, *Ultraviolet radiation, *Organic compounds, *Oil shale wastewater, *Solutes, Radiation, Degradation, Industrial wastewater, Wastewater, Wastewater treatment, Biological treatment, Biological oxidation.

Ozonation and ultraviolet (UV) irradiation were evaluated for their abilities to mineralize organic solutes that remained in a biooxidized oil shale process wastewater and to effect sufficient structural modification of the remaining biorefractory organic solutes to promote secondary biooxidation. Full-spectrum UV radiation failed to mineralize or effect the biooxidation of any of the biorefractory carbon. Although ozonation directly mineralized only 8% of the biorefractory carbon, it enhanced secondary biooxidation; 26% of the refractory carbon was mineralized by an acclimated microbial inoculum. When UV irradiation and ozonation were combined simultaneously, a synergistic effect was observed; 3 h of combined treatment was as effective a pretreatment for secondary biooxidation as was 5 h of ozonation. Sequential application of primary biooxidation, 6 h of combined UV ozonation, and secondary biooxidation removed only 59% of the dissolved organic carbon; total reduction of 87% was achieved by using a culture in the secondary biooxidation step that was specifically adapted to this oxidized water. In general, ozonation and combined UV/ozonation mineralized carbon from the nonpolar fraction; biooxidation of formerly refractory carbon was promoted by oxidation of nonpolar carbon to yield more polar or lower-molecular-weight species. (Author's abstract)
W87-01556

BIOOXIDATION OF ORGANIC SOLUTES IN OIL SHALE WASTEWATERS,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. B. Healy, G. W. Langlois, and C. G. Daughton.
Water Research WATRAG, Vol. 19, No. 11, p 1429-1435, 1985. 3 fig, 4 tab, 26 ref. DOE Contract DE-ACO3-76SF00098.

Descriptors: *Biological oxidation, *Biological wastewater treatment, *Oil shale wastewater, *Organic compounds, *Solutes, Biological treatment, Industrial wastewater, Performance evaluation, Wastewater, Biodegradation, Degradation.

Biooxidation of nine retort waters was evaluated in batch culture. Because losses of dissolved organic carbon (DOC) by volatilization could be extensive (up to 32%), biotreatment was evaluated in screw-capped shake flasks that contained enough headspace to ensure aerobic conditions. Biological removals of DOC ranged only from 9 to 49% using bacteria subjected to extensive enrichment periods. A simple reverse-phase chromatographic fractionation scheme indicated that the majority of refractory DOC for each water resided in the lipophilic fraction (LpF); the polar fraction contained most of the degradable carbon. The LpF organic nitrogen content did not change significantly after biooxidation, and the LpF molar ratio of carbon to nitrogen was similar for each treated water. Molar C:N ratios ranging from 7 to 15 and high UV absorbences indicated that the malodorous and colored solutes associated with the biorefractory LpF consisted mainly of aromatic nitrogenous compounds. Extracellular fluid that remained after exhaustive biooxidation of one wastewater was used in more than 200 enrichment cultures, each of which failed to further remove DOC. (Author's abstract)
W87-01557

HYPERCONCENTRATED CULTURES OF SCENEDESMUS OBLIQUUS: A NEW APPROACH FOR WASTEWATER BIOLOGICAL TERTIARY TREATMENT,
Laval Univ., Quebec. Dept. de Biologie.
A. Lavoie, and J. de la Noue.
Water Research WATRAG, Vol. 19, No. 11, p 1437-1442, 1985. 6 fig, 1 tab, 26 ref.

Descriptors: *Culturing techniques, *Scenedesmus, *Tertiary wastewater treatment, *Biological wastewater treatment, Algae, Chlorophyta, Wastewater treatment, Aquatic algae.

Cultures of the green alga Scenedesmus obliquus at low concentrations provide adequate biological tertiary treatment of wastewaters. The possibility of increasing the system performance was investigated using hyperconcentrated cultures of S. obliquus (up to 2.6 g dry wt per liter) at the laboratory scale. The algal culture grown on secondary effluent was first chemically flocculated with chitosan and decanted; the sedimented culture was then resuspended in secondary effluent to obtain algal suspensions at various concentrations, the performance of which was compared to that of a control culture (0.13 g dry wt per liter). The rate of exhaustion of nitrogen was proportional to the algal concentration, and complete removal could be obtained within 15 min compared to 2.5 h required by the control culture. The unit uptake rate for nitrogen had a tendency to increase with the algal concentration, whereas that of phosphorus showed the opposite relationship. It appears that hyperconcentrated algal cultures have a high potential for the tertiary treatment of wastewaters; a significant reduction of pond surface for large scale operations can be anticipated. (Author's abstract)
W87-01558

PROBLEMS WITH RAPID INFILTRATION--A POST MORTEM ANALYSIS,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed, R. W. Crites, and A. T. Wallace.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 8, p 854-858, August 1985. 5 fig, 7 ref.

Descriptors: *Rapid infiltration, *Performance evaluation, *Case studies, *Wastewater treatment, Design criteria, Planning, Construction, Wastewater facilities, Water quality management.

Rapid infiltration (RI) is a cost-effective method for wastewater management. However, some recently constructed systems have not achieved their design objectives, exhibiting problems that range from complete failure to omissions that limit operational flexibility and effective maintenance. This study examines these problems and recommends solutions. Most problems stem from inadequate field investigations and interpretation of data at the design stage. Moreover, initial project objectives are often lost as an RI system assumes other priorities as a result of technical and institutional pressures. Technical recommendations developed include the following. Field testing is essential at the site and at the planned depth in the soil profile. Construction on backfill should be avoided. Dikes should be as low as possible. Systems should be protected from seasonal groundwater. The process objective of achieving and maintaining design infiltration rates must not be sacrificed to obtain gravity flow or reduce construction costs by balancing cut and fill or insisting on common dikes. Guidelines also are provided for construction design based on clay content and moisture content. (Doria-PTT)
W87-01571

ACTIVATED SLUDGE REACTOR/FINAL CLARIFIER LINKAGES: SUCCESS DEMANDS FUNDAMENTAL UNDERSTANDING,
Havens and Emerson, Inc., Boston, MA.
M. C. Mulbarger, K. L. Zacharias, F. Nazir, and D. Patrick.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 9, p 921-928, September 1985. 4 fig, 2 tab, 1 ref.

Descriptors: *Dissolved oxygen, *Activated sludge, *Wastewater treatment, *Clarification, *Design, *Design criteria, Oxygen, Sludge, Performance evaluation, Bulking sludge, Water quality management, Water quality standards, sludge volume index, Biological oxygen demand.

An operating strategy was developed to achieve controlled activated sludge bulking through induced dissolved oxygen (DO) stress. The success and stability of plant performance are attributed to several practical principles of operation and a fundamental understanding of the linkages between an activated sludge reactor and its final clarifier. Plant performance is described through the first year's operating data. Median suspended sediment (SS) concentration was 4 mg/l, while 92%, 97%, and 99% of the measurements were less than or equal to 10, 15, and 20 mg/l, respectively. This was achieved with a final clarifier undersized by today's regulatory standards and unable to waste solids for 50% of the time in a two-week period. Solids accumulations and DO stresses deteriorated the sludge volume index (SVI) to more than 400 mg/l, resulting in the worst effluent quality under precipitation-induced flow regimes. Determination of biological oxygen demand and final clarifier loading rates show the need for a consistent performance objective if the plant removes only carbonaceous materials. A proposed final clarifier design and operational constant, which reflects the solids loading rate multiplied by the SVI, is suggested in place of more insensitive hydraulic overflow and solids loading rates. (Doria-PTT)
W87-01572

BIOCHEMICAL ASPECTS OF ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL FROM WASTEWATER,
Compagnie Generale des Eaux, Paris (France). Centre de Recherche.
M. C. Hascoet, M. Florentz, and P. Granger.

Water Science and Technology WSTED4, Vol. 17, No. 11/12, p 23-41, 1985. 13 fig, 3 tab, 19 ref.

Descriptors: *Wastewater treatment, *Nutrient removal, *Phosphorus removal, *Biological wastewater treatment, *Activated sludge, Wastewater, Bacteria, Biomass, Biological treatment, Anaerobic digestion, Biodegradation, Aerobic digestion, Nitrates, Copper.

Enhanced biological phosphorus removal from wastewater by microorganisms in activated sludge must include alternating anaerobic-aerobic periods. Biochemical aspects of this phenomenon were investigated using a phosphorus removing biomass obtained in a laboratory-scale pilot with a phases and a synthetic substrate feed. The percentage of phosphorus obtained in the pilot sludge was four times greater than that of a conventional sludge plant. Using nuclear magnetic resonance, the various forms of phosphorus found within cells and their development during the course of alternating phases were determined. The following results were obtained: the transformation of phosphorus in its inorganic to polyphosphate form depends on the medium's level of oxygenation; the presence of nitrates disturbs the anaerobic period but does not affect phosphorus uptake in the aerated period; continuous nitrate addition alters biomass behavior in the anaerobic phase, which loses the capacity to release phosphorus; copper inhibits phosphorus uptake in the aerated phase. Various microbiological analyses made on the pilot biomass isolated conventional bacteria found in activated sludge. (Doria-PTT)
W87-01582

REMOVAL OF VINYLIDENE CHLORIDE FROM GROUND WATER BY AIR STRIPPING AND ACTIVATED CARBON ADSORPTION,
For primary bibliographic entry see Field 5G.
W87-01681

AIR STRIPPING FOR VOCS IN WATER: PILOT-DESIGN-CONSTRUCTION,
For primary bibliographic entry see Field 5G.
W87-01682

BIOLOGICAL TREATMENT OF ETHYLENE GLYCOL-CONTAMINATED GROUND WATER AT NAVAL AIR ENGINEERING CENTER LAKEHURST, NEW JERSEY,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-01683

DRILLING CONTAINMENT SYSTEM FOR HAZARDOUS WASTE SITE INVESTIGATIONS,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-01701

GROUND WATER DECONTAMINATION TECHNIQUES FOR REMOVAL OF FREE FLOATING AND DISSOLVED HYDROCARBONS FROM A WATER TABLE AQUIFER OVERLYING THE FLORIDAN AQUIFER IN SOUTHWEST FLORIDA,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
P. M. Yaniga, and A. A. Kull.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 328-338, 14 fig, 6 tab, 14 ref.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Hydrocarbons *Unconfined aquifers, Florida, Cleanup operations, Distribution pattern, Pumps, Air stripping, Benzene, Toluene, Xylene, Organic compounds, Regulations, Cost analysis.

When dealing with the problem of cleanup operations for oil spills, the approach must be technically sound and acceptable to governing regulatory agencies; it must be physically and economically viable to enact; and it must be acceptable to the impacted parties. This paper discusses one case history, which meets these standards. The product loss occurred in an unconsolidated, shallow water table aquifer underlain by the Floridan Formation. The Floridan Formation, at this location, is under negative head and is separated from the overlying unconsolidated by a thin layer of silty clay. The free product plume was restricted to the upper unconsolidated aquifer in a relatively finite area close to the source of the source. Dissolved product from the spill had migrated outward from the site, in the direction of a water supply well serving four residences and commercial establishments. The groundwater treatment system Ground Water Technology designed, installed and still operates for this situation includes the following: (1) A state-of-the-art, two-pump recovery system for the containment and retrieval of free product; (2) An air stripping tower to remove dissolved benzene, toluene and xylene (BTX) from the pumped water, which is discharged to an infiltration gallery for recirculation to the aquifer; and (3) A physicochemical treatment system on the contaminated water supply well to remove trace levels of organic compounds that impart non-desirable quality to the domestic water supply. This system is successful in reversing the direction of movement of the free product and in recovering the fugitive gasoline, thereby eliminating any potential for an ongoing source of contamination. Additionally, the system removes dissolved organic species and permits water recirculation to the aquifer within the area of influence of the recovery well. The abatement program also provides for the interim treatment of the domestic water supply during the comprehensive cleanup program. (See also W87-01669) (Lantz-PTT)
W87-01708

PUMPED REMOVAL OF IMMISCIBLE PHASES: AN OVERLOOKED ALTERNATIVE AT HAZARDOUS WASTE SITES,
For primary bibliographic entry see Field 5G.
W87-01709

CATALYTIC INCINERATION FOR CONTROL OF VOLATILE ORGANIC COMPOUND EMISSIONS,
Radian Corp., Research Triangle Park, NC.
For primary bibliographic entry see Field 5E.
W87-01768

CORROSION PREVENTION AND CONTROL IN WATER TREATMENT AND SUPPLY SYSTEMS,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 8G.
W87-01769

CENTRALIZED WASTE TREATMENT OF INDUSTRIAL WASTEWATER,
JRB Associates, Inc., McLean, VA.
E. R. Saltzberg, and G. C. Cushnie Jr.
Noyes Publications, Park Ridge, New Jersey, 1985. 415 p.

Descriptors: *Industrial wastewater, *Wastewater treatment, Wastewater management, Wastewater facilities, Germany, Japan, Sludge, Water pollution sources, Cost analysis, Management planning, Water pollution control.

The book addresses the engineering and business-related problems that are encountered by private centralized waste treatment (CWT) firms, local governments, and industry in creating sufficient CWT capacity to meet the growing demand for CWT services. The subject is divided into five chapters aside from the first, introductory chapter: (2) Reviews the CWT facilities used in Germany and Japan, and several research and development projects on CWT conducted by EPA and the DOC in cooperation with a few local governments; (3) Addresses the key design features of centralized treatment facilities. The chapter is organized around the process components of centralized treatment which include waste sources, receiving areas, storage, treatment and recovery, and sludge management; (4) Addresses the technical aspects of establishing a CWT facility. The chapter focuses on procedures for identifying candidate industries and wastes and defining the boundaries of the area that will be serviced by the CWT facility and also discusses the design of a CWT system; (5) Addresses alternatives for managing and financing a centralized treatment facility. Included is a discussion of government assistance programs and an analysis of the dependency between financing and management arrangements; and (6) Presents guidelines for planning a CWT facility. The role of local officials, private investors, and potential industrial users is examined in this chapter. The intent of the chapter is to assist communities to develop and implement CWT plans. (Lantz-PTT)
W87-01770

5E. Ultimate Disposal Of Wastes

INTERMITTENT BIOLOGICAL TREATMENT OF HAZARDOUS WASTES,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-00834

APPLICATION OF BIOTHANE TECHNOLOGY FOR ANAEROBIC TREATMENT OF THERMAL SLUDGE CONDITIONING DECANT LIQUOR,
Biothane Corp., Camden, NJ.
J. Lanting.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 41-54, 2 fig, 7 tab, 14 ref.

Descriptors: *Anaerobic digestion, *Thermal sludge, *Liquid sludge, *Municipal wastewater, Biothane Technology, Sludge solids, Chemical oxygen demand, Biological oxygen demand, Ferric chloride, Hydrogen sulfide, Iowa.

A municipality from the state of Iowa contracted to conduct a feasability study for anaerobic treatment of decant liquor from its thermal sludge conditioning unit. The municipal water pollution control plant is designed to treat an average wastewater flow of 42,000,000 gpd containing a wasteload equivalent to 1,400,000 people although the plant only serves a domestic population of about 200,000 people. The substantial difference is made up by industrial users of the system. The sludge produced by this facility is treated with a thermal sludge conditioning system. This unit is designed to treat up to 200 gpm of sludge with a solids content of 5% at a temperature opf 375 F and a pressure of 350 psi. The produce after decanting has a solids content of about 12%. The overflow from the decant vessel still contains a substantial amount of COD and BOD - typical values are about 25,000 and 12,500 mg/l respectively - and is fed back to the head of the municipal treatment system. The goal of the study was to determine whether this technology would be effective in reducing the wasteload from the sludge conditioning decant liquor. Results achieved were: (1) Volumetric COD loadings of 10 kg of COD/cu m of reactor volume per day could be easily achieved and maintained when using an external dilution of decant liquor with tapwater in a ratio of one to one, (2) Under steady state conditions TCOD and SCOD removals of 72% and 76% were recorded and BOD removals exceeded 90%, (3) The addition of ferric chloride as a means of controlling the hydrogen sulfide concentration in the produced biogas proved very effective, with the hydrogen sulfide content in the biogas dropped 80% to a level of about 0.15% by volume, and, (4) The biomass growth during steady state operation was estimated at 0.07 kg VSS/kg of COD removed. The anaerobic system showed a tendancy toward substantial conversion of the soluble protein fraction in the wastewater, with chemical addition for pH control only required during start up. (See also W87-00832) (Lantz-PTT)
W87-00836

LIME LAKE RECLAMATION VIA SLUDGE MANAGEMENT,
PPG Industries, Inc., Barberton, OH. Barberton Technical Centre.
J. C. Opatrny, and R. C. Larlham.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 261-274, 3 tab, 3 ref.

Descriptors: *Lime lakes, *Land reclamation, *Sludge management, *Municipal wastes, Sludge drying, Land disposal, Chemical properties, Physical properties, Tuscarawas River, Barberton, Ohio, Aquifers.

PPG Industries, Inc., intends to reclaim approximately 600 acres of Solvay Soda Ash Process Waste (Lime Lakes) south of Barberton, Ohio, by incorporating dewatered municipal sludge into the material, recontouring the Lime Lakes with the mixture, and planting them to forest and grassland. In the process, PPG will provide an assured sludge management location for 140 or more dry tons of sludge solids per day (5 days/week) for 20 years or longer. PPG envisions two outcomes. First, a large, aesthetically unpleasing mass of industrial waste will be transformed so that it is consistent with its ecological milieu. Second, a long term solution will be provided for a significant portion of the sludge management problem in Northeast Ohio. In order to assure that this effort will succeed, PPG has spent the past three years, and approximately $1.5 million, in physical, chemical and environmental analyses of the Lime Lakes and their surroundings; and in testing, in the laboratory and in the field, mixtures of sludge and lime lake material. Results discussed concern: (1) the structure of lime lakes; (2) physical properties of lime lakes; (3) chemical properties of lime lakes; (4) the Tuscarawas River Valley aquifer; (5) municipal wastewater treatment plant sludge; (6) socioeconomics; (7) lake reclamation, sludge management and groundwater management; and, (8) public relations. (See also W87-00832) (Lantz-PTT)
W87-00850

ORGANIC FLUIDS EFFECTS ON THE STRENGTH, DEFORMATION AND PERMEABILITY OF SOIL-BENTONITE SLURRY WALLS,
Woodward-Clyde Consultants, Plymouth Meeting, PA.
J. C. Evans, I. J. Kugelman, and H. -Y. Fang.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 275-291, 8 fig, 2 tab, 9 ref. EPA Grant No. R-810922.

Descriptors: *Organic compound, *Soil-bentonite slurries, *Permeability, Physical properties, Waste disposal, Bentonite, Slurries, Clays, Liners, Carbon tetrachloride, Acetic acid, Aniline.

The disposal of wastes in the subsurface environment has resulted in the extensive application of soil-bentonite slurry trench cutoff wall technology for the control of these wastes. The reliable performance of these waste containment systems requires an understanding of the interaction between the wastes and the engineering properties of the soil-bentonite backfill used in slurry trench cutoff walls. The results of a study investigating the effect of selected organic fluids on the strength, deformation, and permeability of soil-bentonite backfill are presented. The investigation was conducted utilizing triaxial cell permeameters specifically designed and constructed to conduct long-term permeability tests with a wide range of chemical permeants. After permeation the samples were sheared in undrained triaxial shear to evaluate their strength and strain properties. Described in this paper are the results of long-term permeability testing with three organic fluids (carbon tetrachloride, acetic acid, and aniline). The effect of organic fluid concentration was also studied. The studies demonstrated that permeation with concentrated organic fluids caused a significant increase in permeability. Dilute (solubilized) solutions of the same fluid had a significantly less detrimental effect upon the permeability of the soil-bentonite backfill. The data relating the strength and deformation data and organic fluid concentration is inconclusive. (See also W87-00832) (Lantz-PTT)
W87-00851

FEASIBILITY STUDY OF THE USE OF LIME SLUDGE AS LANDFILL LINER,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
D. Raghu, and H. -N. Hsieh.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 305-313, 2 fig, 3 tab, 5 ref.

Descriptors: *Landfill liners, *Lime sludge, *Feasibility studies, Sludge disposal, Wastewater disposal, Landfills, Groundwater protection, Leachates, Groundwater pollution.

The purpose of this paper is to present an alternate method for sludge disposal, rather than continuing the use of sewerage system disposal and landfilling. Sanitary landfill still remains the most common method for the disposal of solid wastes. Current estimates indicate that over 500 million tons of municipal and industrial wastes are disposed of in landfills and that there are 250,000 acres of active sanitary landfills in the United States. It is projected that approximately 197 million tons of solid wastes will be generated in the United States in 1990. One of the major problems encountered in landfills is the production of leachate. The leachates are generated when surface water or groundwater becomes contaminated as it passes through layers of refuse. If leachates penetrate into the soil strata, a series of pollution problems may result. To protect groundwater, liners must be constructed of materials that have compatible chemical properties and sufficient strength and thickness to prevent failure. In most landfills, both industrial and municipal, the liner systems consist of both a primary liner (synthetic) and a secondary liner, which can be soil or synthetic. In this study, an effort is being made to evaluate the possibility of using lime sludge as a secondary landfill liner. Based on the tests performed, it appears that it would be feasible to use lime sludge as a liner for landfills. This is based on the following reasons: (1) Lime sludge is impervious; and, (2) It is anticipated that there will not be any serious problems associated with the placement and compaction of sludge in the field. However, it is suggested that more consolidation testing should be conducted to verify the results. Also, it is recommended that permeability tests should be performed after soaking the sludge with representative samples of leachates from landfills. (See also W87-00832) (Lantz-PTT)
W87-00853

EPICHLOROHYDRIN IN SECONDARY CONTAINMENT SYSTEMS,
Carlisle SynTec Systems, PA.
For primary bibliographic entry see Field 5B.
W87-00854

SUCCESSFUL CHEMICAL RECOVERY BY EVAPORATIVE AND MEMBRANE TECHNIQUES,
For primary bibliographic entry see Field 5D.
W87-00855

CLOSURE OF A HAZARDOUS WASTE SURFACE IMPOUNDMENT,
Spotts, Stevens and McCoy, Inc., Wyomissing, PA.
J. J. Oransky, and G. D. Kraft.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 367-373.

Descriptors: *Hazardous wastes, *Waste disposal, *Surface impoundments, Case studies, Sampling, Chemical analysis, Management planning, Field tests, Contamination.

This paper is presented as a case study and traces the cooperative problem solving techniques used by all concerned parties to close, and ultimately dispose of solid material in a hazardous waste impoundment. The problem solving techniques outlined here include an integrated approach utilizing chemical, civil, and environmental engineering, environmental chemistry, communication skills, and management practices to successfully interact with State environmental officials as well as implement a cost effective solution to the client's problem. Several years ago, Spotts, Stevens and McCoy, Inc. was contracted by a well-established and successful industrial firm to provide engineering and analytical services necessary to close an existing surface impoundment located on company property. The impoundment studied had been in existence for 19 years and was used for disposal of electroplating sludge from the client's production operations. In order to successfully close the impoundment and ultimately dispose of solid material in the impoundment, the following problem solving methodology was utilized: (a) Initial site investigation and interview of plant personnel to determine the process variables; (b) Initial sampling and analytical testing to determine magnitude of problem; (c) Closure plan formulation, negotiations, review, and approval by State environmental officials; (d) Field sampling by core boring contractor to obtain soil and rock samples for detailed analytical testing; (e) Analytical testing of field samples to determine volume and extent of impoundment contamination; (f) Bid solicitation from suitable and compatible hazardous waste disposal facilities and licensed transporters; and (g) Interaction with State environmental officials regarding implementation of final disposal in accordance with approved closure plan. (See also W87-00832) (Lantz-PTT)
W87-00857

ASSESSMENT OF WASTE DISPOSAL SITES: UTILIZING EXPERT SYSTEMS,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-00858

NEW MEMBRANE TECHNOLOGY IN THE METAL FINISHING INDUSTRY,
Carltech Associates, Inc., Cranford, NJ.
For primary bibliographic entry see Field 5D.
W87-00862

AGRICULTURAL USE OF INDUSTRIAL WASTE - A FOCUS ON SOLUTION -,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
L. M. Naylor.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 475-484, 1 fig, 5 tab, 9 ref.

Descriptors: *Recycling, *Impaired water use, *Water reuse, *Agriculture, Industrial wastewater, Nitrogen, Phosphorus, Potassium, Calcium, Land application.

A situation which has not been widely publicized in recent years, is that there are a great many industries, particularly the agriculturally related industries whose residual by-products contain nontoxic, potentially useful constituents that can be utilized beneficially in agriculture. Examples of such useful items would include water, nitrogen, phosphorus, potassium, calcium, magnesium, organic matter, and trace minerals such as copper and zinc. Recycling these beneficial constituents through agriculture as opposed to landfill, incineration, or discharge to waters can offer important benefits to the generator, the user and the environment. These benefits are associated strongly with the fact that what may be pollutant in one segment of the environment may be a resource in another. The key to successful recycling of residues is the identification of the physical, chemical and biological characteristics of the residues and the creative and beneficial integration of these items into environmental systems. A second reason to consider

recycling of industrial residues through agricultural systems is that management alternatives such as landfilling and incineration are becoming limited due to environmental or economic constraints. For the past 6 years, the residuals management program at Cornell University has been investigating creative uses of industrial residues in agriculture. These residues have sometimes been referred to as wastes, and unfortunately, this may mean they were resources which have been wasted. Examples are the residuals from brewery, dairy, and cheese wastewater treatment. Others are fermentation residues, composts produced by a pharmaceutical company, kiln dust from a cement manufacturer, and fly ash from wood burning operations at a pulp and paper industry. These residuals were evaluated for agricultural use based on their N-P-K content or their mineral content (Ca, K). In general, biological residues from fermentation or wastewater treatment operations tend to be richer in the macronutrients and organic matter. In fact, an alternative definition of a wastewater treatment plant is: A fertilizer production facility using as raw materials the by-products of agro-industrial processes. Agricultural use of these residuals can improve soil fertility and enhance crop yield and quality, and where properly designed, managed and monitored can benefit with both generator and the user. (See also W87-00832) (Lantz-PTT)
W87-00864

AEROBIC BIODEGRADATION OF LEACHATE AND FORCED EXTRACTS FROM A SLUDGE DISPOSAL LAGOON,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
J. D. Boyer, M. B. King, D. S. Kosson, and R. G. Ahlert.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 497-508, 5 fig, 7 tab, 4 ref.

Descriptors: *Aerobic biodegradation, *Leachates, *Forced extracts, *Sludge disposal, *Sludge lagoons, Primary sludge, Secondary sludge, Percolation, Groundwater pollution, Metabolism, Glucose, Carbon.

Clean-up of a sludge disposal lagoon is to be undertaken. The lagoon contains more than 30,000 cu yd of primary and secondary sludges. The primary (lime neutralized) and secondary (biological) sludges resulted from treatment of effluent from diverse chemical manufacturing processes. Rainwater percolating through the landfill has prompted concern over the impact of leachate on local groundwater. Forced extraction to hasten the disintegration of the landfill is being investigated. Samples of the primary and secondary sludges have been extracted with 0.005 N sodium hydroxide. Aerobic biodegradation of forced and natural leachates can be used to eliminate some of the hazardous organic compounds present in solution. It has been observed that mixed microbial populations are capable of metabolizing organic compounds found in leachates from industrial landfills. The microbial transformation of supposedly xenobiotic compounds can be incorporated into more usual and naturally-occuring biochemical pathways. Metabolism may be of two types: (1) A chemical that is easily metabolized can act as an energy source and support growth as well; and, (2) A chemical does not serve as a source of growth but can be metabolized (cometabolism). Cometabolism may play a significant role in the degradation of anthropogenic compounds. This process is possibly a result of the limited substrate specificity for some microbial transport mechanisms and enzymes. Previous investigations studied the effects of initial glucose concentration on the biodegradation of natural and forced extracts. It was reported that the initial glucose concentration did not have any effect on percent reduction of organic species. This report looks more closely at the effects glucose has on the microbial population and its ability to biodegrade natural and forced extracts. A supplementary carbon source was required for microbial growth. The glucose did not effect the percent leachate organic carbon reduction. Aerobic degradation is not capable of reducing the organic species more than 50%. Therefore, conventional aerobic biodegradation, i.e., secondary treatment, may not be appropriate. (See also W87-00832) (Lantz-PTT)
W87-00866

ECONOMIC AND TECHNICAL ANALYSIS OF DRYING SLUDGE THROUGH COMPOSTING AND AIR DRYING,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
F. C. Miller, and M. S. Finstein.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 509-522, 3 fig, 3 tab, 14 ref. EPA Project R-806829010.

Descriptors: *Economic evaluation, *Sludge drying, *Composting, *Air drying, Vaporization, Biological treatment, Evaporation, Cost analysis, Field tests, Dewatering.

Biological drying of sewage sludge through composting, in which vaporization is driven through heat generated microbially at the expense of putrescible organic matter, is a field proven technology. Non-biological air drying is commonly employed, sometimes informally, to remove water from sludge or composting material. The present paper concerns a three-way comparison among air drying and two different approaches to composting. Air drying is accomplished with or without 'heat', using either evaporative cooling alone, or heat created by combustion of fossil fuels. This method, though effective is much less efficient that water removal through biological drying through composting. The composting process relies on biological heat generation with removal of the heat by adequate ventilation. Economic functions (efficiency and rate and extent of water removal), theoretical comparisons of water removal efficiency, field demonstrations of air drying, data interpretation of are drying, and an economical analysis of air drying are presented. (See also W87-00832) (Lantz-PTT)
W87-00867

MANAGING RESIDUAL SOLID WASTES IN AN AIRCRAFT ENGINE MANUFACTURING FACILITY,
Garrett Turbine Engine Co., Phoenix, AZ. Plant Engineering Dept.
For primary bibliographic entry see Field 5D.
W87-00868

USE OF SHORT-TERM TESTS TO EVALUATE THE POTENTIAL TOXICITY OF A TEXTILE WASTE IN A LAND APPLICATION SYSTEM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
M. J. Degen, G. D. Boardman, and R. B. Reneau.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 563-573, 1 tab, 8 ref.

Descriptors: *Short-term tests, *Toxicity, *Textile mill wastes, *Land application, Tissue analysis, Wastewater disposal, Antibiotics, Chemical analysis, Field tests.

A better method is needed to assess the toxicity of waste materials to the plant covers of land treatment systems. In this study, soil and tissue parameter analyses were within acceptable limits even though the tissue was noticeably damaged by the treatments. The visual assessments used in this study, although subjective, are used routinely and successfully in a number of agronomic assays. To reduce potential biases, however, visual assessments are best performed by a panel of qualified, experienced personnel. A panel of that caliber would be difficult and expensive for most laboratories to assemble. Visual assessments also do not evaluate sublethal effects that may harm the overall vigor of the plant, placing the plant at a competitive disadvantage in a field situation. Concluding remarks about the results obtained in this study are as follows: (1) Based on the information obtained from the visual assessments and the chemical analyses of the plant tissue and the greenhouse soils, an application rate of 308 kg N/ha/yr is recommended for the 99.5% main process wastewater (MPW) and 0.5% antimicrobial wastewater (AMW); (2) The lumac analysis may be acceptable for use with known biological populations, but the variations that occur in natural biological populations appear to weaken the precision of the analysis; (3) The Microtox analysis is simple to perform, can be completed in one hour, and the results are reproducible. The Microtox analysis is, therefore, a good candidate test for both screening and monitoring; and (4) The Corn Seedling bioassay was easy to perform and could be completed in less than a week. The root test was more sensitive than the other seedling bioassays and was considered a good screening test. The length of the test would preclude its use as a monitoring tool. Short term bioassays have the potential to play an important role in assessing the toxicity of waste materials. Perhaps their greatest utility will be to provide data which complement the information obtained from a more complete and informative long-term bioassay that uses representative life forms from the receiving system. The tests might also be used as monitoring tools given that a satisfactory correlation can be established between the short-term bioassay results and receiving system effects. (See also W87-00832) (Lantz-PTT)
W87-00869

DUWAMISH WATERWAY CAPPING DEMONSTRATION PROJECT: ENGINEERING ANALYSIS AND RESULTS OF PHYSICAL MONITORING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. L. Truitt.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report D-86-2, March 1986. Final Report. 54 p, 19 fig, 4 tab, 8 ref, 2 append.

Descriptors: *Dredge spoil disposal, *Waste disposal, *Washington, *Duwamish Waterway, *Capping, *Demonstration projects, Contained aquatic disposal, Engineering, Monitoring, Dredging, Environmental effects, Bathymetry, Sonar, Sand, Suspended solids, Mathematical analysis.

The US Army Engineer District, Seattle, and the US Army Engineer Waterways Experiment Station have cooperated in a project in the Duwamish Waterway that successfully demonstrated the engineering aspects of subaqueous disposal and capping of contaminated dredged material. Approximately 1,100 cu yd of silty, clayey shoal material was removed by clamshell dredge, transported by barge, and bottom dumped through 70 ft of water into an existing depression. The site was then capped with successive loads of clean sandy cover. The technique has been termed contained aquatic disposal. This paper summarizes the initial fieldwork and presents results through the first (6-month) monitoring effort. The engineering effectiveness of the material placement and capping operation is examined using comparisons of replicate bathymetry and side scan sonar. The analysis indicates that the contaminated material exited the barge rapidly and descended to the bottom quickly as a well-defined, cohesive mass. Clean sand was applied successfully as a cap without displacing the softer contaminated material. A volumetric balance of materials is presented together with an error analysis for the calculated volumes based on the precision of the surveys used. Sufficient geotechnical information was also collected to allow for an approximate mass balance calculation. Sources for potential losses of material during the operation are examined. In particular, resuspension of sediment was measured during both the dredging and the disposal operations. A computer-aided method was developed to allow for rapid comparisons of suspended solids levels at different depths in the water column and at various sampling stations. (Author's abstract)
W87-00879

EXPECTED BRINE CHEMISTRY IN A NUCLEAR WASTE REPOSITORY IN SALT,

Weston Consultants, Rockville, MD.
For primary bibliographic entry see Field 5C.
W87-00904

APPLICATION OF MULTIPLE-OBJECTIVE PROGRAMMING TO THE EVALUATION OF SEWAGE-SLUDGE-DISPOSAL ALTERNATIVES,
Oak Ridge National Lab., TN. Energy Div.
R. D. Perlack, and C. E. Willis.
Available from the National Technical Information Service, Springfield, VA. 22161, as CONF-810542-1, Price codes: A03 in paper copy, A01 in microfiche. 1981. 11 p, 1 tab, 9 ref.

Descriptors: *Planning, *Evaluation, *Sludge disposal, *Multiobjective planning, Wastewater treatment, Alternative planning, Cluster analysis, Boston, Massachusetts, Risk, Disposal, Economic aspects, Environmental effects, Ocean dumping, Land application.

A set of non-inferior solutions was generated for disposal of primary sewage sludge at two wastewater treatment plants in Boston Harbor. It was necessary to find an alternative to disposal through submerged outfalls into the outer harbor. Economic benefits, environmental impact, and risk were considered the non-commensurable objectives. Cluster analysis was used to prune the non-inferior set. As expected, the high cost solution (multiple disposal modes) had least effect on the environment. The low cost solution, ocean disposal, had the most environmental impact. Agricultural land application was intermediate in both cost and environmental impact. (Cassar-PTT)
W87-00947

INFLUENCE OF LEACH RATE AND OTHER PARAMETERS ON GROUNDWATER MIGRATION,
Dames and Moore, White Plains, NY.
For primary bibliographic entry see Field 5B.
W87-00954

DECOMPOSITION OF POTATO PROCESSING WASTES IN SOIL,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 5B.
W87-01155

EFFECTS OF A GLUCOSE-IMPOSED OXYGEN DEMAND ON LAND TREATMENT SYSTEMS,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
For primary bibliographic entry see Field 5C.
W87-01156

SAN FRANCISCO FINISHES OUTFALL,
J. J. Kosowatz.
Engineering News Record, Vol. 217, No. 1, p 34, July 3, 1986.

Descriptors: *San Francisco, *Outfall, *Sewers, *Sewer systems, *Storm sewers, Outfall sewers, Construction, Water pollution control.

San Francisco is starting the second major project in its clean water program with the placement in the Pacific of final segments of outfall pipe. The 4-1/2 mile long, 12-foot diameter outfall will begin discharging as much as 130 mgd of partially treated sewage and stormwater from the mew $350 million sewerage system serving the west side of the city in August, 1986, one month ahead of schedule. (Doria-PTT)
W87-01158

COMPARISON OF COMPOSTING OF TWO SEWAGE SLUDGES,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
For primary bibliographic entry see Field 5D.
W87-01188

RADIONUCLIDE UPTAKE BY TREES AT A RADWASTE POND IN WASHINGTON STATE,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 5C.
W87-01203

APPROACH TO SEWAGE SLUDGE BIOACCUMULATION POTENTIAL TESTS,
Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 5C.
W87-01305

BIOLOGICAL IMPLICATIONS OF THE MANAGEMENT OF WASTE MATERIALS: THE IMPORTANCE OF INTEGRATING MEASURES OF EXPOSURE, UPTAKE, AND EFFECTS,
National Ocean Service, Seattle, WA. Ocean Assessments Div.
For primary bibliographic entry see Field 5C.
W87-01310

IMPLICATIONS OF WASTE DISPOSAL IN COASTAL WATERS ON FISH POPULATIONS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
For primary bibliographic entry see Field 5C.
W87-01313

SCREENING OF ORGANIC MATTER IN LEACHATES FROM SANITARY LANDFILLS USING GAS CHROMATOGRAPHY COMBINED WITH MASS SPECTROMETRY,
State Chemical Supervision Service, Soeborg (Denmark).
For primary bibliographic entry see Field 5A.
W87-01464

ANAEROBIC REACTORS TREATING BEET SUGAR EFFLUENTS,
Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
For primary bibliographic entry see Field 5D.
W87-01513

PEROXYGENS IN ENVIRONMENTAL PROTECTION,
Interox Chemicals Ltd., Widnes (England).
For primary bibliographic entry see Field 5D.
W87-01518

OVERVIEW OF ENVIRONMENTAL SURVEILLANCE OF WASTE MANAGEMENT ACTIVITIES AT THE IDAHO NATIONAL ENGINEERING LABORATORY,
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 5G.
W87-01762

CATALYTIC INCINERATION FOR CONTROL OF VOLATILE ORGANIC COMPOUND EMISSIONS,
Radian Corp., Research Triangle Park, NC.
M. S, Jennings, N. E. Krohn, R. S. Berry, M. A. Palazzolo, and R. M. Parks.
Noyes Publications, Park Ridge, New Jersey, 1985. Pollution Technology Review No. 121. 251 p.

Descriptors: *Volatile organics, *Organic compounds, *Water pollution control, *Incineration, Combustion, Cost analysis, Industrial wastes, Ozone, Smog, Atmospheric deposition, Catalytic incinerators.

This book describes and evaluates the use of catalytic incinerators for the control of industrial volatile organic compound (VOC) emissions. It provides an overview of how catalytic incinerators are applied to industrial VOC emissions, and assesses the overall performance typically achieved in various applications. Catalytic incineration is a combustion control technique in which the oxidation reactioin occurs at lower temperatures than thermal incineration, with the help of a catalyst, allowing oxidation reactions to occur rapidly in the temperature range 700 to 900 F. By contrast, a range of 1300 to 1500 F is required for practical oxidation rates in thermal incinerators. Significant energy savings are possible using catalytic incineration. A major attraction of catalytic incinerators is reduced fuel costs. The emission of VOCs from industrial plants significantly increases ambient levels of photochemical oxidants, ozone, and smog. Control of industrial VOC emissions, therefore, can result in substantial environmental benefits. Part I of the book describes catalytic incineration as applied to the control of industrial VOC emissions and assesses the overall performance, applicability, and costs as compared to alternate VOC control technologies. Part II describes the results of case studies which gathered actual performance data through a field testing program on existing operating industrial catalytic incinerators. (Lantz-PTT)
W87-01768

5F. Water Treatment and Quality Alteration

PRETREATMENT OF FLUORIDE BEARING WASTEWATERS,
BCM Engineers, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5D.
W87-00838

TREATMENT OF COOLING TOWER WATER BY DISSOLVED AIR-OZONE FLOTATION,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 207-216, 1 fig, 3 tab, 19 ref.

Descriptors: *Cooling towers, *Cooling water, *Dissolved air flotation, *Ozonation, Water quality, Wastewater treatment, Recycling.

Recent studies have shown that preozonation of drinking water tends to increase removal of color, particulates, organics and trihalomethane precursors. When considering the problems of various solids contamination, deposition and microbiological contamination in cooling tower water, suggested clarification of the water may involve the process of dissolved air flotation (DAF) technology. In a recycle flow pressurization DAF system the addition and quality of recycle water will have an overall affect on effluent water quality. While the process of dissolved air flotation is known to successfully reduce various solids and turbidity in raw and process waters, the additional use of ozone to improve recycle water quality and therefore overall water quality has not been extensively studied. This laboratory study investigates the affect of ozonation on recycle water and the relative improvement of overall water quality after flotation treatment. This study indicates that the addition of ozone into the flotation process is effective and may in certain cooling systems produce the optimum treatment at reasonable cost. Major constituents causing scaling and deposition problems are effectively removed after the treatment described. Several recommendations for future study are advisable. First it would be advantageous to study the affect of recycle water ozonation in an industrial plant with cooling towers to determine the feasibility in a larger scale system. Also, the use of pure ozone instead of air in the addition of the supersaturated recycle water might prove effective giving a more concentrated concentration of ozone to add more directly to the process. Laboratory experimentation to develop a method of dissolved ozone flotation would prove informative and possibly lead to more cost effective treatment of cooling tower systems. (See also W87-00832) (Lantz-PTT)
W87-00846

GROUNDWATER MODELING FOR ASSESSING REMEDIAL ALTERNATIVES AT A SUPERFUND SITE,
Jordan (Edward C.) Co., Inc., Portland, ME.

W. a. Murray, R. A. Lewis, and E. G. Hill.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 238-245, 2 fig, 1 tab.

Descriptors: *Groundwater pollution, *Model studies, *Groundwater decontamination, Waste disposal, Morristown, Illinois, Landfills, Chemical wastes, Leakage, Aquifers, Leaching.

The ACME Solvent Savers waste disposal site is located in a rural area near Morristown, Illinois. Drummed waste materials were transported to the site which were either emptied into unlined disposal lagoons or stockpiled. ACME was ordered to clean up the site in 1972, but inspections showed that the wastes had not been removed, rather that several of the lagoons had been covered with soil. Additionally, an unknown number of drums had been crushed or buried whole. Subsequent investigations have revealed that the shallow aquifer underlying the site has been contaminated by organic chemicals presumably leached from the lagoons and/or leaking drums. The USGS model developed by Konikow and Bredehoeft was used to simulated the groundwater flow conditions. Model calibration was based on: (1) observations of field conditions; (2) topographic map of the area; (3) interpretive profiles of the site geology; (4) measured groundwater levels in observation wells; (5) hydraulic conductivities determined from field tests; (6) contaminant distributions established by sampling and analysis of groundwater; and (7) meteorological records. After analyzing the model data, a treatment scheme was devised, indicating that through the use of models, and model interpretation, engineering decisions could be implemented for remedial actions at hazardous waste sites. (See also W87-00832) (Lantz-PTT)
W87-00848

REMOVAL OF CADMIUM FROM CONTAMINATED GROUNDWATERS THROUGH COPRECIPITATION AND ADSORPTION IN LIME SOFTENING OPERATIONS,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
T. -K. Chang, and R. W. Peters.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 455-474, 7 fig, 6 tab, 18 ref.

Descriptors: *Cadmium, *Groundwater pollution, *Chemical precipitation, *Adsorption, Lime, Hydrogen ion concentration, Heavy metals, Calcium carbonate.

This paper addresses the removal of cadmium by coprecipitation and adsorption in the lime-soda ash water softening process, with initial hardness levels of 150, 250, and 350 mg/l and cadmium levels of 0, 1.0 and 5.0 mg/l. Since heavy metals are very common sparingly soluble salts in hard waters, this represents a very practical and real investigation on the effects of impurities on calcium carbonate precipitation and the simultaneous removal of heavy metals by the lime softening process. The higher cadmium level (5.0 mg/l) was used to address the coprecipitation and adsorption mechanisms responsible for removal of cadmium. Cadmium can be very effectively removed from contaminated groundwaters using conventional lime softening operations. Trace level cadmium concentrations (Cd sub i $<$ or $=$ 1.0 mg/l) have no effect on the batch precipitation of CaCO3. Such concentrations are typical of many contaminated groundwaters. Higher initial cadmium concentrations (approximately 5.0 mg/l) interfered with the precipitation of CaCO3, suggesting a threshold concentration of approximately 2 mg/l for a noticeable inhibition on CaCO3 crystal growth. Using 5.0 mg/l of cadmium initially caused the residual calcium level to increase 20-30%. Calcite was the only morphological form observed for the continuous CaCO3 precipitation. In the absence of impurities such as cadmium, the kinetically favored metastable aragonite form predominates. Thus, the presence of impurities severely inhibits aragonite growth, causing the thermodynamically favored calcite form to prevail. No effect is experienced on the removal of magnesium due to the presence of cadmium. The residual calcium concentration increased approximately 30-40 mg/l in the presence of cadmium indicating the inhibitory effect of cadmium on CaCO precipitation. Such behavior explains why almost all municipalities employing lime softening operations have calcite as the predominant crystalline CaCO3 form, due to the fact that most groundwaters contain trace levels of inorganic contaminants. Removal of cadmium is greatest in the early stages of the runs due to a larger adsorptive capacity. Removal of cadmium is due primarily to physical adsorption onto the CaCO3 sludges. It is felt these results should also be applicable to wastewater treatment operations. (See also W87-00832) (Lantz-PTT)
W87-00863

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,
Hach Co., Loveland, CO.
For primary bibliographic entry see Field 5A.
W87-00918

SUMMARY OF METHODS FOR WATER-QUALITY ANALYSIS OF SPECIFIC SPECIES,
Geological Survey, Arvada, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W87-00919

REMOVAL OF ENDOTOXIN FROM WATER BY MICROFILTRATION THROUGH A MICROPOROUS POLYETHYLENE HOLLOW-FIBER MEMBRANE,
Mitsubishi Rayon Co. Ltd., Nagoya (Japan). Product and Development Center.
Y. Sawada, R. Fujii, I. Igami, A. Kawai, and T. Kamiki.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 4, p 813-820, April 1986. 6 fig, 5 tab, 37 ref.

Descriptors: *Filtration, *Water treatment, *Wastewater treatment, *Drinking water, *Endotoxin, Pyrogen, Escherichia coli.

The removal of endotoxin (lipopolysaccharide (LPS)), a major pyrogen, from water or parenteral substances is of major importance for manufacturing processes and in quality control. The microporous polyethylene hollow fiber (EHF) membrane has a unique microfibrile structure throughout its depth and has been found to possess the functions of filtration and adsorption of endotoxin in water. The membrane has a maximum pore diameter of approximately 0.04 micron, a diameter which is within the range of microfiltration. Approximately 10 and 20% of the endotoxin in tap water and subterranean water, respectively, was smaller than 0.025 micron. Endotoxin in these water sources was efficiently removed by the microporous polyethylene hollow-fiber membrane. Escherichia coli 0113 culture broth contained 26.4% of endotoxin smaller than 0.025 micron which was also removed. Endotoxin was leaked into the filtrate only when endotoxin samples were successively passed through the membrane. Endotoxin smaller than the pore size of the membrane was adsorbed and then leaked into the filtrate because of a reduction in binding sites. Dissociation of 3-H-labeled endotoxin from the membrane resulted in the removal of endotoxin associated with the membrane by alcoholic alkali at 78% efficiency. It is concluded that the EFH membrane can be used to remove endotofin from water used in laboratories, pharmaceutical houses, and health care facilities. (Peters-PTT)
W87-00985

PERSISTENCE OF LEGIONELLA PNEUMOPHILIA IN NON-STERILE, STERILE AND ARTIFICIAL HARD WATERS AND THEIR GROWTH PATTERN ON TAP WASHER FITTINGS,
Centre for Applied Microbiology Research, Salisbury (England).
For primary bibliographic entry see Field 5B.
W87-01010

INFLUENCE OF TEMPERATURE ON THE NUMBER OF LEGIONELLA PNEUMOPHILIA IN HOT WATER SYSTEMS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5B.
W87-01011

REGIONAL REACTIVATION OF GRANULAR ACTIVATED CARBON,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
J. Q. Adams, R. M. Clark, B. W. Lykins Jr., and D. Kittredge.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 38-41, May 1986. 6 tab, 4 ref.

Descriptors: *Water treatment, *Filtration, *Activated carbon, Carbon, Reactivation, Manchester, New Hampshire, Fluidized-bed reactivation, Regional reactivation.

A major proportion of the cost of using granular activated carbon as a water treatment unit process is associated with the replacement or reactivation of spent carbon. Regional reactivation, the sharing of a reactivation furnace among several users, has been proposed as a means of minimizing this cost. To test this concept, a field-scale regional reactivation project was conducted by the Manchester (NH) Water Works in conjuntion with three other water utilities. Of the three participating utilities, each provided 40,000 lb (18 160 kg) of carbon to be transported to Manchester for fluidized-bed reactivation. Data were gathered on reactivation operations and costs, transportation costs, and carbon losses. The results of the study demonstrated that regional reactivation can be cost effective compared with carbon replacement and, in certain instances, compared with on-site reactivation. (Author's abstract)
W87-01018

INDUSTRIAL USE OF REVERSE OSMOSIS,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5D.
W87-01020

FRENCH CONNECTION: CUISINE AND WATER TREATMENT,
I. M. Sayre.
American Water Works Association Journal JAWWA5, Vol 78, No. 7, p 52-61, July 1986. 7 fig.

Descriptors: *Rural areas, *Urban areas, *France, *Water treatment facilities, *Taste, Chromium, Nitrate, Nice, Paris, Chlorination, Privatization, Industrial pollution, Agricultural pollution, Raw water, Monitoring, Automation, Process control, Economics.

French water supply systems are described based on a tour taken in 1986; two objectives were: (1) to discover how effective privatization of water services is in serving remote rural areas; and (2) to obtain information on some advanced techniques used. Small rural facilities, the showcase plant at Nice, and removing specific pollutants (chromium, nitrate) in plants in the Paris suburbs are described. Cultural preferences in France mandate different treatment objectives than in the United States. The taste of chlorine is deplored throughout France, so that its use is limited. Industrial and agricultural pollution of source waters challenges French water suppliers to the utmost. There is a strong emphasis on research, which in some cases has permitted use of highly contaminated source waters. Automated monitoring systems and treatment controls further enhance the ability to meet unforeseen variations in the quality of raw water. (Rochester-PTT)
W87-01021

PROVIDING WATER FOR THE ILE DE FRANCE,
Compagnie Generale des Eaux, Paris (France).
M. M. Bourbigot, and J. Sibony.

American Water Works Association Journal JAWWA5, Vol. 78, No. 7, 62-71, July 1986. 9 fig, 1 tab, 26 ref.

Descriptors: *Paris, *Urban areas, *Water treatment facilities, Monitoring, Training, Chlorination, Bacterial analysis, Raw water, Nitrification, Process control, Water supply systems, Activated carbon.

Water treatment approaches employed in the Ile de France (Paris metropolitan) area of France are described, including organization of the supply utilities, strategies for ensuring safe and flexible water supplies, automated monitoring and control techniques, bacteriological monitoring, clarification, flocculation, and multistage ozonation. Paris area water producers responded to deteriorating quality of raw water with a number of strategies. The formation of organochlorinated compounds often led to moving the chlorination stage to the end of the treatment train and, as an adjunct, developing biological nitrification processes. For the same reasons, ozonation and use of activated carbon have become important parts of the treatment scheme. In recent years, the use of on-line control instrumentation to control the quality of treated water has increased. It has involved the installation of automated monitoring stations upstream of the water intake and the adaptation of on-line measuring devices to control the injection of reagents. (Rochester-PTT)
W87-01022

DESALINATION: THE SOLUTION TO OMAN'S THIRST,
Ministry of Electricity and Water, Muscat (Oman).
For primary bibliographic entry see Field 3A.
W87-01024

ORGANIZATIONAL AND SYSTEM IMPROVEMENTS IN CAIRO,
General Organization for Greater Cairo Water Supply (Egypt).
K. E. D. Hegab.
American Water Works Association Journal JAWWA5, Vol. 78, No. 7, p 86-91, July 1986. 3 fig, 3 ref.

Descriptors: *Management planning, *Cairo, *Water supply systems, Training, Inventory control, Finance, Accounting, Water treatment facilities, Water quality control, Telemetry, Iron, Manganese, Mobile workshops, General Organization for Greater Cairo Water Supply, Personnel.

Continuous efforts are being made by the General Organization for Greater Cairo Water Supply (GOGCWS), which serves about 8 million residents and received 15,000 new service applications in 1984, to improve both its organization and its systems. Two major problems confronting GOGCWS are a shortage of technical personnel and the confusing diversity of equipment and technologies that have been received from various countries around the world. Upgrading of GOGCWS is discussed, including training, inventory control, control of water wastage, financial and accounting programs, treatment plant expansion, water quality control, engineering and planning programs, telemetering, iron and manganese removal and mobile workshops. (Rochester-PTT)
W87-01025

NEW APPROACH TO TREATMENT PLANT DESIGN AND CONSTRUCTION IN LATIN AMERICA,
Hidrosan Ltd., Bogota (Colombia).
J. Arboleda-Valencia.
American Water Works Association Journal JAWWA5, Vol. 78, No. 7, p 92-105, July 1986. 18 fig, 3 tab, 25 ref.

Descriptors: *Water treatment facilities, *Latin America, *Design criteria, Chemical dosing, Coagulants, Hydraulic mixing, Parshall flumes, Creager weirs, Spillways, Flocculation, Plate settlers, Filtration, Sand, Anthracite coal, Sedimentation.

A new approach to water treatment plant design has been developed in Latin America. It simplifies operation and maintenance and reduces capital costs without lowering filtered water quality. Chemical dosing is done with simple gravity feeders using only two-story buildings and applying the coagulants in nonconcentrated solution from large storage tanks. Mixing is always done hydraulically, using Parshall flumes and Creager weirs (ie, a round-crested overflow spillway). Flocculation systems are commonly constructed with hydraulic drives for small treatment plants and mechanical drives (conventional paddles) for large treatment plants. Plate settlers are used not only for new plants, but for upgrading existing facilities. Filtration has been simplified drastically by the employment of (1) a dual-media filter bed of sand and anthracite coal; (2) backwashing of a filter unit from the effluent from other units; and (3) the use of delining-rate filtration. Sedimentation with plate settlers and filtration approaches is emphasized in the discussion. (Rochester-PTT)
W87-01026

OPTIMIZING DIRECT FILTRATION IN BRASILIA,
J. R. Bratby.
American Water Works Association Journal JAWWA5, Vol. 78, No. 7, p 106-115, July 1986. 12 fig, 3 tab, 8 ref.

Descriptors: *Brasilia, *Pilot plants, *Filtration, Water treatment facilities, Turbidity, Cationic polyelectrolytes, Metals, Preflocculation, Backwash rates, Process control, Brazil.

Results of laboratory and pilot-plant studies designed to define the optimal conditions for direct filtration at the Brasilia, Brazil, water treatment plant are presented. The use of ferric chloride offered definite advantages (longer filter runs and lower effluent turbidities) over the use of alum. For the raw waters studied, the use of cationic polyelectrolytes to reduce the metal coagulant dosage was not feasible. Preflocculation prior to direct filtration was unnecessary and even could be detrimental to performance. With the coarse filter bed adopted, high backwash rates are required, but with lower than normal total volumes of backwash water. (Author's abstract)
W87-01027

ALUMINUM-THIOUREA INHIBITORS OF MILD STEEL CORROSION IN HIGH SPECIFIC SALINITY WATER. COMPATIBILITY WITH CALCIUM, MAGNESIUM AND FERROUS IONS AT VARIOUS TEMPERATURES,
Higher Inst. of Mechanical and Electrical Engineering, Sofia (Bulgaria).
For primary bibliographic entry see Field 3C.
W87-01104

DESIGN OF THE GAC TREATMENT FACILITY AT CINCINNATI,
Pirnie (Malcolm), Inc., White Plains, NY.
G. P. Westerhoff, and R. Miller.
American Water Works Association Journal JAWWA5, Vol. 78, No. 4, p 146-155, April 1986. 10 fig, 2 tab, 8 ref.

Descriptors: *Water treatment facilities, *Activated carbon, *Cincinnati, *Design criteria, Pilot plants, Absorption, Carbon filters, Regeneration, Fluidized beds, Control systems, Automation, Computers.

Design criteria, development studies and process flows for a granular activated carbon (GAC) drinking water treatment facility in Cincinnati, OH are described. The objectives and results of pilot-scale studies of GAC absorption and on-site carbon regeneration facilities are reviewed. Features of the system include 12 gravity GAC contactors and a fluidized bed carbon regeneration system. The control systems are computer-assisted, operator controlled processing elements for monitoring and control of liquid stream and furnace operations and GAC handling. When the plant becomes operational in 1988, the use of GAC is expected to remove low levels of organic compounds that are always present in the city's water source. (Michael-PTT)
W87-01130

THM AND TOX FORMATION: ROUTES, RATES, AND PRECURSORS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. D. Johnson, and J. N. Jensen.
American Water Works Association Journal JAWWA5, Vol. 78, No. 4, p 156-162, April 1986. 7 fig, 8 tab, 62 ref.

Descriptors: *Trihalomethanes, *Total organic halogen, *Chlorination, *Chemical reactions, *Water treatment, Oxidation, Chlorine, Chlorine dioxide, Chloramines, Drinking water, Fulvic acid, Organic compounds.

The mutagenic character of chlorinated drinking water is closely associated with the nonvolatile higher-molecular-weight fraction of chlorinated organic compounds. These compounds comprise a majority of the halogenated compounds formed in drinking water chlorination. Both trihalomethane (THM) and total organic halogen (TOX) must be considered when monitoring chlorination practice or considering changes to the treatment process. This article reviews the chemistry of aqueous chlorine, traces the routes to THM and TOX and provides a comparative analysis of chlorine dioxide and chloramines used for reduction of THMs. (Michael-PTT)
W87-01131

REMOVING TRACE ORGANICS BY REVERSE OSMOSIS USING CELLULOSE ACETATE AND POLYAMIDE MEMBRANES,
Stanford Univ., CA. Dept. of Civil Engineering.
M. Reinhard, N. L. Goodman, P. L. McCarty, and D. G. Argo.
American Water Works Association Journal JAWWA5, Vol. 78, No. 4, p 163-174, April 1986. 4 fig, 13 tab, 25 ref.

Descriptors: *Organic compounds, *Reverse osmosis, *Cellulose acetate membranes, *Wastewater treatment, *Water treatment, *Polyamide membranes, Water treatment facilities, Organic carbon, Pilot plants, Trace levels, Pretreatment of water, Effluents.

Reverse osmosis (RO) was evaluated in terms of removing selected organics under full-scale and pilot-scale treatment plant conditions using cellulose acetate (CA) and polyamide (PA) membranes, respectively. The full-scale system removed total organic carbon (TOC) by 89% at an 84% water recovery rate, while the pilot systems removed TOC by 99% at recovery rates of 52 and 67%. The membranes differed in their ability to reject trace organics such as volatiles, purgeables, neutrals, bases, phenols and acids from lime-clarified wastewater. All membranes rejected branched, complex molecules. Rejection characteristics varied for smaller molecules like chlorinated solvents which were rejected in varying degrees by the PA membranes, but passed through CA membranes. The near complete removal of general organics suggests that TOC in the RO effluent consists primarily of small trace compounds. More data is needed to fully account for individual compounds of TOC. (Michael-PTT)
W87-01132

COMPETITIVE ADSORPTION AMONG VOCS ON ACTIVATED CARBON AND CARBONACEOUS RESIN,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W87-01134

UPRATING AND UPGRADING SLOW SAND FILTERS BY PRE-OZONATION,
Thames Water Authority, London (England).
A. Rachwal, D. Rodman, J. West, and T. Zabel.
Effluent and Water Treatment Journal EWTJAG,

Vol. 26, No. 5/6, p 143-149, May 1986. 10 fig, 4 tab, 4 ref.

Descriptors: *Water treatment, *Slow sand filters, *Filters, *Uprating, *Upgrading, *Preozonation, Thames Water Authority, Water treatment, Sand filters.

The potential of pre-ozonation as a means of both uprating slow sand filter performance, in terms of increased filter run length or throughput, and upgrading slow sand filters in terms of organics removal is discussed. Slow sand filtration was one of the earliest processes used to treat water for public supply. At low filtration rates there is only a superficial penetration of suspended matter into the bed and a biological film, the Schmutzdecke, develops in the top few cm of the sand, enhancing filteration of the fine particles and providing a degree of biological removal of inorganic and organic materials. More than 70% of the direct operating costs for slow sand filters are associated with filter cleaning and resanding, mainly in the form of labor and mobile plant costs. Reducing the average frequency of filter cleaning and resanding could reduce slow sand filter operating costs significantly. The use of ozone to improve the slow sand filtration process was initiated in the UK by the Metropolitian Water Board in the early 1970's but due to pilot plant reliability problems the results were not conclusive. In 1980 the Thames Water Authority began ozone-slow sand filter studies. During periods of high algal activity above the bed, pre-ozonation increased average filter run lengths of slow sand filters operated at conventional filtration rates from 60 days to more than 90 days before maximum headloss was reached. At times of high turbidity, and during periods of low algal activity, pre-ozonation had no beneficial effect on slow sand filter run length. (Khumbatta-PTT)
W87-01205

PCB REMOVAL BY CONVENTIONAL WATER TREATMENT: EFFECT OF CHEMICAL COAGULATION AND CHLORINATION,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
O. A. Aly, and M. I. Badawy.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 929-934, June 1986. 3 tab, 15 ref.

Descriptors: *Polychlorinated biphenyls, *Water treatment, *Coagulation, *Chlorination, Drinking water, Aluminum sulfate, Ferric chloride.

Conventional treatment with coagulants was found to have little effect on the removal of PCBs from test solutions. Ferric chloride was less effective in PCB removal than aluminum sulfate. Percentage removal ranged from 10% to 40% depending on the dose of coagulant; increasing the coagulant dose from 25 to 50 mg/l resulted in considerable removal, with little additional change in percent removal as the dose was increased to 100 mg/l. The addition of an increasing dose of coagulant aid (Nalco) to a fixed dose of both aluminum sulfate and ferric chloride improved coagulation and PCB removal; maximum percentage removal was obtained with 50 mg/l aluminum sulfate and 0.2 mg/l Nalco. PCBs of low molecular weight were removed better than were the high-molecular weight Aroclors. The effect of chlorination on raw river water samples containing PCBs was also studied. Although some isomers disappeared, the number of isomers increased after treatment with chlorine due to the formation of new isomers of higher molecular weight, indicating the transformation of PCB isomers containing fewer chlorine atoms into those containing more chlorine atoms by an addition reaction. The dose of chlorine and contact time have an effect on the formation of new isomers and their concentration. (Doria-PTT)
W87-01224

METHOD FOR PREDICTING THE RATE OF ABIOTIC DEGRADATION OF ORGANIC CHEMICALS IN THE ENVIRONMENT, (EINE VORAUSSAGEMETHODE ZUM ABIOTISCHEN ABBAUVERHALTEN VON ORGANISCHEN CHEMIKALIEN IN DER UMWELT),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Radiochemie.
For primary bibliographic entry see Field 5B.
W87-01334

APPLICABILITY OF ION-EXCHANGERS IN CA-FORM FOR THE REMOVAL OF SOLUBLE LEAD IN BERLIN HOUSEHOLD WATER, (EIGNUNG VON IONENAUSTAUSCHERN IN DER CA-FORM ZUR ENTFERNUNG DES ECHT GELOESTEN BLEIANTEILS IM BERLINER HAUSHALTSWASSER),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
W. Arts, L. Bauch, and H. -J. Bretschneider.
Zeitschrift Wasser und Abwasser ZWABAQ, Vol. 18, No. 6, p 244-247, December 1985. 4 fig, 3 tab, 15 ref.

Descriptors: *Drinking water, *Lead, *Berlin, *Ion exchangers, Heavy metals, Amberlite IRC84, Resins, Water pollution sources, Plumbing, Ions.

The presence of heavy metals, especially lead, in drinking water is primarily a consequence of plumbing corrosion. Six different ion exchangers were investigated by bench tests for their ability to reduce the content of soluble heavy metal ions or ion complexes. The resins were first converted to their Ca form to suppress changes in the make-up of the drinking water. Amberlite IRC84 proved to be the best ion-exchange material in terms of kinetics. Long-duration tests showed that for a flow of 10 l/h, a resin volume of 100 ml and an inlet concentration of c(Pb)= 320 micrograms/l that the threshhold value of 40 micrograms/l is reached after 3000 liters have passed the exchanger. Discontinuous operation tests showed that diffusion into the interior of the granule is the rate-determining step. Certain problems remain to be solved: the danger of bacterial growth, and the fact that complete removal is not effected. For extremely high concentrations of lead (> 300 micrograms/l) a combination of ion exchange and filtration (sand or activated charcoal) would be required. (Airone-PTT)
W87-01336

TOC-, TIC-, AND TC-INVESTIGATIONS OF MATERIALS FOR CONTACT WITH POTABLE WATER, (TOC-, TIC-, UND TC-BESTIMMUNGEN AN WERKSTOFFEN FUER DEN TRINKWASSERBEREICH),
Bonn Univ. (Germany, F.R.). Hygiene Inst.
For primary bibliographic entry see Field 5A.
W87-01338

INJECTION ANALYSIS WITH FLOW-GRADIENT SYSTEMS: A NEW APPROACH TO UNSEGMENTED FLOW TECHNIQUES,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
A. Rios, M. D. Luque de Castro, and M. Valcarcel.
Talanta TLNTA2, Vol. 32, No. 9, p 845-850, September 1985. 9 fig, 18 ref.

Descriptors: *Flow injection analysis, *Flow-gradient, *Water analysis, Water treatment, Sampling rate, Flow rates, Kinetics, Reservoirs, Flow velocity, Bromocresol green, Potassium dichromate, Ascorbic acid, Pyridoxal thiosemicarbazone, Mathematical analysis.

Flow gradients controlled by a variable hydrostatic head have been employed in flow injection analysis (FIA) for the first time. The influence of these gradients on the most characteristic parameters of an FIA recording have been studied in systems with and without a chemical reaction. The study performed allows the following conclusions. The establishment of a flow-gradient in an FIA system modifies the peak profiles to give shapes between those obtained by use of the initial and final flow-rates of the gradient tested. Positive or negative flow-gradients affect the parameters of an FIA peak differently. When no chemical reaction takes place, the most significant influence of the gradient is on parameters such as base-line to base-line and peak area and is stronger for positive gradients. When the system involves a chemical reaction, use of a flow-gradient allows the degree of reaction at the instant of detection to be increased or decreased at will. The practical advantages derived from the use of a flow-gradient in FIA are: (a) increase in sampling rate; and (b) resolution of mixtures by differential kinetics. (Main-PTT)
W87-01414

WATER DESALINATION IN SOLAR EARTH STILLS: A NUMERICAL STUDY,
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
For primary bibliographic entry see Field 3A.
W87-01446

SURVEY OF VOLATILE HALOGENATED ORGANICS (VHO) IN ITALY: LEVELS OF VHO IN DRINKING WATERS, SURFACE WATERS AND SWIMMING POOLS,
Modena Univ. (Italy). Ist. di Igiene.
For primary bibliographic entry see Field 5B.
W87-01463

OZONATION OF ORGANIC HALIDE PRECURSORS: EFFECT OF BICARBONATE,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Reckhow, B. Legube, and P. C. Singer.
Water Research WATRAG, Vol. 20, No. 8, p 987-998, August 1986. 7 fig, 1 tab, 45 ref.

Descriptors: *Ozonation, *Water treatment, *Organic compounds, *Halides, *Bicarbonates, Drinking water, Fulvic acid, Trichloracetic acid, Dichloroacetic acid, Trichloracetone, Kinetics, Hydrogen ion concentration, Chlorination, Precursors.

A laboratory study of the effect of bicarbonate on the ozonation of organic halide precursors in fulvic acid solutions and in a raw drinking water was conducted as the experimental variables. The experimental variables were bicarbonate concentration, ozone dose and pH of chlorination. Results are expressed in terms of trihalomethane (THM), total organic halide (TOX), trichloracetic acid, dichloroacetic acid, trichloroacetone and dichloroacetonitrile precursor concentrations. Kinetic studies showed that bicarbonate slowed the decomposition of ozone in the presence of fulvic acid, and thereby, led to a greater degree of destruction of u.v.-absorbing substances. Similarly, precursor destruction increased with increasing bicarbonate concentrations in the range of 0.0001 - 0.01 M. Precursor destruction was greatest when chlorination was performed at low pH. At high pH's of chlorination, some precursor enhancement was noted, especially in the absence of bicarbonate. Results are interpreted both from a mechanistic standpoint and with respect to their applicability to water treatment practice. (Author's abstract)
W87-01467

RELATIONSHIP AMONG TURBIDITY, PARTICLE COUNTS AND BACTERIOLOGICAL QUALITY WITHIN WATER DISTRIBUTION LINES,
Rohm and Haas Co., Spring House, PA.
W. F. McCoy, and B. H. Olson.
Water Research WATRAG, Vol. 20, No. 8, p 1023-1029, August 1986. 5 fig, 3 tab, 18 ref. EPA Grant No. CR809817010.

Descriptors: *Turbidity, *Water quality, *Particulate matter, *Bacterial analysis, Heterotrophic bacteria, Potable water, Drinking water, Water quality standards.

The turbidity standard for quality was evaluated in relation to total particle counts, heterotrophic plate counts and epifluorescence direct cell counts of three different municipal drinking-waters. Turbidity and particle counts were directly proportional. There was no predictable relationship between bacteriological quality and turbidity or particle counts. Heterotrophic plate counts under-estimated epifluorescence direct cell counts by a factor of at

least 500. Water quality degradation occurred in municipal drinking-water systems because of intermittent short duration events that resulted in high turbidity, particle counts and heterotrophic plate counts. Further, for all parameters measured variability increased with distance traveled within a pipe except for groundwater. (Author's abstract)
W87-01472

SPECTROPHOTOMETRIC STUDY OF THE FORMATION OF AN UNIDENTIFIED MONOCHLORAMINE DECOMPOSITION PRODUCT,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5A.
W87-01478

METHYLENE NUMBER EVALUATING SORPTION CAPACITY OF ACTIVATED CARBON,
Bialystok Technical Univ. (Poland). Dept. of Civil Engineering.
J. Paprowicz.
Effluent and Water Treatment Journal EWTJAG, Vol. 26, No. 5/6, p 163-167, May 1986. 5 tab, 14 ref.

Descriptors: *Water treatment, *Sorption capacity, *Activated carbon, Carbon, Pellicular capacity, Methylene blue, Aqueous solutions.

Activated carbons are widely used for the purification of aqueous solutions. Proper evaluation of carbons has a very important role in sorption processes. Choice of sorbents is made by means of the use of proper model substances representing the given group of pollutants. One of the most frequently used indicatiors to evaluate activated carbons is methylene blue. The studies required the standardization of both preparation methods of methylene blue and methodology and determination of sorption kinetics and sorptions capactities of carbons for different concentrations. The porous structure of carbons has been determined in order to compare sorption effects and to represent the full characteristics of carbons. This paper has described 24 sorbents of different porous structure. Carbons differ in form, origin and in methods of activation. Scales of production were also different. Tested carbons came from 8 different producers, in order to carry out comparative studies of methylene blue sorption by different methods and to test the greatest number of experimental materials. A very important factor for evaluation of carbons produced by different producers was to establish a constant initial concentration of methylene blue to be used for all methods. Methylene blue as an indicator should be used for the evaluation of carbon sorbents of impurities of middle-size particles. Evaluation of carbons should be verified in real conditions and then technological parameters should be determined. (Khumbatta-PTT)
W87-01514

CHLORAMINES: A BETTER WAY,
H. Smallowitz.
Civil Engineering (ASCE) Vol. 56, No. 4, p 50-51, April 1986.

Descriptors: *Chloramines, *Trihalomethanes, *Water treatment, *Carcinogens, Disinfection, Chlorination, Water quality.

Water chlorination has been linked to the formation of a number of suspected carcinogens. Chlorination is great at killing the pathogens in our drinking water. But several years ago, it was discovered that chlorine may also be killing us. Some locales began disinfecting their water with chloramines. Chloramines' main advantage over free chlorine is that they do not react with the organic matter present in some water. But when mixed with free chlorine, some materials of concern are produced. These materials, called trihalomethanes (THMs), have been shown to be carcinogenic in animal studies. Alternative disinfection systems also can be expensive, requiring major system retrofits, costly chemicals, or both. Most communities with excessively high THM levels found chloramines to be the only realistic alternative available. Like any new system, chloramination has its implementation problems. But unlike many other systems, they are relatively easy and inexpensive to correct. The National Toxicology Program in Research Park Triangle, NC, in conjunction with EPA is conducting a study of chloramines to see if they have any cancer causing effects. (Khumbatta-PTT)
W87-01521

TREATMENT PLANT OPERATOR ASSESSES OZONATION,
Monroe Water Works, MI.
W. L. LePage.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 44-48, August 1985. 1 tab, 7 ref.

Descriptors: *Water treatment, *Ozonation, *Monroe, *Michigan, *Performance evaluation, *Cost effectiveness, Taste, Odors, Organoleptic properties, Economic aspects, Cost analysis.

Ozonation of the public water supply at Monroe, Michigan is reviewed by the plant operator after six years of successful operation. Destruction of taste and odor, the primary objective of ozonation at Monroe, has been complete under all conditions. Numerous side effects of ozonation for taste and odor control are reported to be beneficial; among them are the elimination or reduction of the use of chlorine and other chemicals, improved coagulation and settling with alum, extended filter runs, reduction in frequency of filter backwashing, reduction in waste washwater treatment charges, partial to complete disinfection, stabilized chlorine residuals, reduction in concentration of trihalomethanes, rapid destruction of cyanide, deodorized sludge sumps, indication of impending raw water quality changes, satisfaction of immediate oxidant demand, elimination of consumer complaints, and substantial savings in labor costs in numerous areas. Treatment results, equipment performance, and economics are compared with the rigid criteria originally applied in the process selection and design. All comparisons remain favorable as the system enters its seventh year of operation. (Doria-PTT)
W87-01538

PREPURCHASING OZONE EQUIPMENT,
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
R. D. G. Monk, R. Y. Yoshimura, M. G. Hoover, and S. H. Lo.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 49-54, August 1985. 9 fig, 1 tab, 8 ref.

Descriptors: *Cost analysis, *Planning, *Ozonation, *Economic aspects, *Purchasing, *Water treatment facilities, Filtration, Los Angeles, Water treatment, Pretreatment of water, Flocculation, Disinfection.

The design of the Los Angeles Aqueduct Filtration Plant calls for pretreatment with ozone to aid in flocculation, to control tastes and odors, to reduce trihalomethane production, to serve as a disinfectant, and to aid in the removal of turbidity. Specifications for the ozone system allowed bidders to choose among several alternatives and postponed the final design of the building housing the ozone system until the equipment had been selected. The bid documents for the ozone system required that specific data be supplied along with bids to ensure a cost-effective facility over a life cycle of 20 years. Experience with ozone systems of comparable size also was required. This unusual bidding procedure resulted in an estimated cost savings for the city of Los Angeles of more than $5 million. (Author's abstract)
W87-01539

FACTORS CONTROLLING THE REMOVAL OF ORGANIC POLLUTANTS IN OZONE REACTORS,
Drexel Univ., Philadelphia, PA. Dept. of Environmental Engineering.
M. D. Gurol.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 55-60, August 1985. 11 fig, 1 tab, 13 ref. EPA Agreement R-811128-01-0.

Descriptors: *Ozonation, *Organic compounds, *Water treatment, *Model studies, *Performance evaluation, Chemical properties, Mass transfer, Ozone, Cost analysis, Cost effectiveness, Economic aspects.

A model has been developed to determine the efficiency of removing organic contaminants in ozone reactors based mainly on the reactivity and volatility of the contaminants. The chemical composition of the water, the mass transfer characteristics of the reactor, and certain operational conditions (flow rates of the gas and water, concentration of ozone in the applied gas stream, and detention time) were identified as the process parameters that control the performance of ozone reactors. Once the methodology has been developed to measure all key parameters, the model can be used to evaluate different operational alternatives for optimum performance of ozone reactors and to make performance and cost comparisons between ozonation and other processes, such as activated carbon adsorption and air stripping. Because of the assumption of complete mixing in aqueous phase, the application of the model to very tall bubble columns may be limited. For packed and tall bubble columns, the process phenomena can be described by a set of differential equations that can be solved by numerical techniques. (Doria-PTT)
W87-01540

USING OZONE AND ULTRASOUND TO REDUCE RO MEMBRANE FOULING,
Civil Engineering Lab. (Navy), Port Hueneme, CA.
J. C. Lozier, and R. A. Sierka.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 60-65, August 1985. 10 fig, 2 tab, 18 ref. DOI OWRT Grant 14-34-001-0456.

Descriptors: *Ozone, *Ultrasonics, *Reverse osmosis, *Membrane processes, *Water treatment, Osmosis, Humic acids, Ozonation, Silica, Membranes.

The usefulness of ozone and ultrasound in reducing the potential of humic acids to foul reverse osmosis membranes was studied. Ozonation alone increased the filterability of low concentrations of humic acids (5 mg/L). Applied flow rates of 114 mg ozone/min for one minute produced the most significant filterability increase. However, the application of ultrasound during ozonation was detrimental, probably because the sound waves reduced the average particle size of colloidal and suspended solids in the solution. The presence of colloidal silica in the humic acid solutions further reduced the fouling potential through the formation of a porous prefilter on the surface of the simulant RO membrane. The greatest reduction of total organic carbon occurred under ozonation without ultrasound at an initial pH of 5.5. (Doria-PTT)
W87-01541

OZONE-GAC FOLLOWING CONVENTIONAL US DRINKING WATER TREATMENT,
Construction Engineering Research Lab. (Army), Champaign, IL.
S. W. Maloney, I. H. Suffet, K. Bancroft, and H. M. Neukrug.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 66-73, August 1985. 4 fig, 4 tab, 34 ref. EPA Grant Cr 806256-02.

Descriptors: *Ozone, *Activated carbon, *Water treatment, *Drinking water, *Ozonation, Carbon, Chlorination, Cost effectiveness, Organic compounds, Adsorption, Biodegradation.

The combination of ozonation followed by granular activated carbon (GAC) has been suggested as a means of improving the cost effectiveness of the GAC process for removal of organic compounds. Several combinations of ozonation and chlorina-

tion were analyzed for their effects on GAC adsorption. Although ozonation increased biodegradation of dissolved organic carbon, the ozone process was shown to interfere with the ability of GAC to treat volatile halogenated organics. Ozonation appears to increase competition for adsorption sites between volatile halogenated organics and the natural background organic matrix. The use of ozonation in water treatment must therefore be judged as a trade-off between its benefits (e.g., taste and odor reduction and disinfection) and its potential for adverse effects (e.g., increased competition in the low-molecular-weight ranges for adsorption sites on GAC). (Doria-PTT)
W87-01542

EFFECTS OF OZONE AND STORAGE TEMPERATURE ON GIARDIA CYSTS,
Battelle Memorial Inst., Columbus, OH. Environmental and Health Sciences Section.
G. B. Wickramanayake, A. J. Rubin, and O. J. Sproul.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 74-77, August 1985. 3 fig, 3 tab, 26 ref. EPA Grant R808150-02-0.

Descriptors: *Giardia, *Ozone, *Water temperature, *Disinfection, *Survival, Public health, Giardiasis, Parasites, Ozonation, Water treatment, Physical properties, Temperature, Diseases.

The effects of ozone and storage temperature on the survival of Giardia lamblia cysts, the cause of human giardiasis, and Giardia muris, a parasite of mice, were compared. The viabilities of the cysts were similar over a storage period of 25 days in the range of -6 to 37 C; the optimum temperature for their long-term survival was about 5 C. Ozone was extremely effective for inactivating cysts of both Giardia species, with G. muris being consistently more resistant than G. lamblia at pH 7 and 5 C and 25 C. (Author's abstract)
W87-01543

REMOVING FULVIC ACID BY LIME SOFTENING,
National Chunghsing Univ., Taichung (Taiwan). Dept. of Environmental Engineering.
M. Y. Liao, and S. J. Randtke.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 78-88, August 1985. 12 fig, 6 tab, 57 ref. EPA Cooperative Agreement 806819.

Descriptors: *Fulvic acids, *Water treatment, *Lime, *Water softening, Groundwater, Dissolved solids, Calcium carbonate, Adsorption, Public health.

Jar tests have demonstrated that lime softening can remove a significant fraction of fulvic acid extracted from groundwater. Removal of the fulvic acid was attributed to coprecipitation and involved its adsorption onto calcium carbonate crystals during the early stages of the softening reaction, retarding their growth and distorting their shape. Favorable conditions for removal included a high pH, an excess of divalent calcium, a minimum amount of carbonate, and finely divided calcium carbonate solids of poor crystallinity. Test results suggest that the softening process can be modified to improve the removal of fulvic acid without compromising the removal of hardness. Experiments with different fractions of groundwater humic material indicate that removability of each fraction is associated with its adsorbability onto calcium carbonate and its ability to bind divalent calcium. (Doria-PTT)
W87-01544

BACKWASHING AND CONDITIONING OF A DEEP BED FILTER,
Bekaert (N.V.) S.A., Zwevegem (Belgium).
R. J. Francois, and A. A. Van Haute.
Water Research WATRAG, Vol. 19, No. 11, p 1357-1362, 1985. 7 fig, 6 tab, 11 ref.

Descriptors: *Backwash, *Deep bed filters, *Mathematical studies, *Water treatment, *Filtration, Model studies, Coagulation, Flocculation, Filters.

The traditional conceptual model explaining the initial effluent degradation as a result of the backwashing of a deep filter bed is insufficient. It is demonstrated mathematically and experimentally that the initial break-through is only 5% due to particles captured in the backwash water at the end of the backwash operation. The number of those particles is not affected by the rate of shutdown of the backwash. The initial turbidity peak is 95% due to a lack of filter efficiency resulting from inadequate pore structure. The filter is in regime only after the blocking of the small pores and dead zones. The rate of blocking is strongly influenced by the physicochemical treatment of the raw water and by a pretreatment of the filter bed. An increased dose of coagulant at the start of the filtration or a preconditioning of the filter bed during the last minutes of the backwashing operation can reduce the initial turbidity peak; this treatment also has consequences for the complete filter run. (Doria-PTT)
W87-01548

FEASIBILITY OF COAGULANT RECYCLING BY ALKALINE REACTION OF ALUMINUM HYDROXIDE SLUDGES,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
W. J. Masschelein, R. Devleminck, and J. Genot.
Water Research WATRAG, Vol. 19, No. 11, p 1363-1368, 1985. 9 fig, 2 tab, 15 ref.

Descriptors: *Alkaline treatment, *Feasibility studies, *Recycling, *Coagulation, *Sludge, *Water treatment, Economic feasibility, Sludge disposal, Water treatment facilities, Heavy metals.

Coagulant recycling appears to be economically attractive as much by the reduction of fresh chemical dosing as by the simplification of sludge disposal. The feasibility of aluminum coagulant recovery by an alkaline treatment of sludge was studied on sludge obtained from a drinking water treatment plant on the river Meuse, Brussels. The following guidelines were developed: (1) Starting sludge concentrations should be limited to a threshold below 20 g per liter dry weight concentration. (2) The pH should be maintained between 11.4 and 11.8 for NaOH and between 11.2 and 11.6 for Ca(OH)2. (3) Although either NaOH or Ca(OH)2 can be used, heavy metals in the sludge are reduced by a factor of 10-15 using lime instead of NaOH. (4) A settling process should be used to recover the supernatant before recycling, limiting coagulant recovery to 25-30%, although 80% recovery is possible using NaOH. No detrimental effect on the treatment performance was noted when recycling was restricted to less than 50% of the coagulant (25-30%). (Author's abstract)
W87-01549

MASS TRANSFER MECHANISMS IN A HETEROTROPHIC BIOFILM,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5D.
W87-01550

INACTIVATION OF HETEROTROPHIC BACTERIAL POPULATIONS IN FINISHED DRINKING WATER BY CHLORINE AND CHLORAMINES,
California Univ., Irvine. Program in Social Ecology.
R. L. Wolfe, N. R. Ward, and B. H. Olson.
Water Research WATRAG, Vol. 19, No. 11, p 1393-1403, 1985. 9 tab, 50 ref.

Descriptors: *Water treatment, *Heterotrophic bacteria, *Population dynamics, *Drinking water, *Chlorine, *Chloramines, *Disinfection, Reservoirs, Flavobacterium, Chlorination, Pseudomonas, Acinetobacter.

The die-off of heterotrophic bacteria from a finished drinking water reservoir in southern California was evaluated using chloramines and free chlorine. Understanding the inactivation of heterotrophic populations is valuable because it reflects the response to disinfection of naturally occurring organisms in their native state and environments. Disinfection studies with the heterotrophic bacterial group were performed during summer and winter months using different chloramine application techniques at pH 6 and 8. The inactivation experiments indicated that the die-off with free chlorine was influenced predominantly by the presence of highly chlorine tolerant, red-pigmented bacteria, identified as Flavobacterium spp. Inactivation by chloramines was chiefly dependent upon the method of application and pH. Viable bacteria recovered from the indigenous population after 60 min of exposure to chloramines included species of Pseudomonas, Acinetobacter, and Flavobacterium. In general, with contact times of 1 h or more, free chlorine and chloramine solutions (1.0-1.6 mg per liter, pH 8) reduced total count levels below 50 colony forming units per milliliter. (Author's abstract)
W87-01553

CORROSION PREVENTION AND CONTROL IN WATER TREATMENT AND SUPPLY SYSTEMS,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 8G.
W87-01769

5G. Water Quality Control

TOXIC AND HAZARDOUS WASTES: PROCEEDINGS OF THE SEVENTH MID-ATLANTIC INDUSTRIAL WASTE CONFERENCE, JUNE 23-25, 1985.
For primary bibliographic entry see Field 5D.
W87-00832

RESPONSE OF A DENSE FLUID UNDER PUMPING STRESS,
For primary bibliographic entry see Field 2F.
W87-00847

GROUNDWATER MODELING FOR ASSESSING REMEDIAL ALTERNATIVES AT A SUPERFUND SITE,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5F.
W87-00848

MONITORING THE HYDROLOGY AND CHEMISTRY OF A DRY FLY ASH LANDFILL,
TRC Environmental Consultants, Inc., East Hartford, CT.
J. A. Ripp, and J. F. Villaume.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 292-304, 3 fig, 3 tab, 2 ref.

Descriptors: *Landfills, *Monitoring, *Fly ash, *Chemical analysis, Hydrologic properties, Model studies, Mathematical analysis, Leachates, Runoff, Clean Water Act, Field tests.

The study of waste streams, specifically leachate and stormwater runoff, emanating from the dry landfilling of coal combustion fly ash has, until recently, been limited to laboratory scale extractions or mathematical simulations. Most existing landfill leachate and runoff monitoring networks are designed to detect quality changes in ground and surface water during and after landfill construction. These requirements are based primarily on the need of the states to adopt Best Available Technology (BAT) for discharges to groundwater under the Resource Conservation and Recovery Act (RCRA) and to surface water under the Clean Water Act's National Pollutant Discharge Elimination System (NPDES). In the late 1970's Pennsylvania Power & Light Company (PP&L) began the process of converting their fly ash disposal system from wet (lagoon) disposal to dry disposal. Planning on a 1982 conversion date, PP&L in 1978 began a laboratory simulation and computer modeling study of the physical and chemical environ-

mental factors which produce fly ash leachate and runoff. An initial field study, designated Phase I, sought to characterize the surface runoff and the ash and pore water during a one-year hydrologic monitoring program. The Phase I study was completed in the fall of 1983 and provided a basis for the design of a new and hydraulically controlled test cell of fly ash, the subject of this paper. The test cell was constructed in the early fall of 1984 with full time data acquisition beginning on October 20, 1984, and continuing for at least one full monitoring year. Eventually, modeling studies will be initiated to provide leachate production predictions. Chemical transport models for unsaturated fly ash will be attempted in 1986. The data being collected is constantly being verified with at least three different techniques used to determine moisture changes within the ash. A monthly water budget is calculated using the Thornthwaite equation for evapotranspiration and the calculated change in pile moisture is compared monthly against the tensiometer and neutron logging data. As the data from this test cell are manipulated and analyzed, empirical models of the hydrology and transport in the unsaturated zone will be constructed. (See also W87-00832) (Lantz-PTT)
W87-00852

CLOSURE OF A HAZARDOUS WASTE SURFACE IMPOUNDMENT,
Spotts, Stevens and McCoy, Inc., Wyomissing, PA.
For primary bibliographic entry see Field 5E.
W87-00857

ASSESSMENT OF WASTE DISPOSAL SITES: UTILIZING EXPERT SYSTEMS,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
G. K. Mikroudis, J. L. Wilson, and H. Y. Fang.
IN: Toxic and Hazardous Wastes: Proceedings of the Seventh Mid-Atlantic Industrial Waste Conference, June 23-25, 1985. Technomic Publishing Co., Lancaster, PA. 1985. p 374-386, 2 fig, 10 ref, 1 append.

Descriptors: *Waste disposal sites, *Assessments, *Monitoring, Waste management, Contamination, GEOTOX, Computer programs, Remote sensing, Management planning.

There are many approaches to the problem of hazard condition assessment and corresponding rating of contaminated sites. The EPA, for instance, uses a Hazard Ranking System to assess sites where contamination of drinking water is quite probable. The use of such a system is limited to prioritizing sites for the application of a monitoring program. Another well known system is the standardized system for evaluating waste disposaal sites proposed by LeGrand. His methodology provides a concise screening mechanism for evaluating the contamination potential of waste sites prior to intensive investigations. There are also other systems such as the one by Hagerty, Pavoni, and Heer, which is well suited for field investigations and detailed site assessment. A comprehensive overview of several proposed and practical methods of assessing the impacts of waste disposal sites on groundwater quality is given by Milner and Roy. An alternative to these methods, which can be used successfully during the phases of preliminary investigations, as well as in-situ investigations/field work, has been proposed by the authors, and is called GEOTOX. Using a computer-integrated engineering system as described by the Wilson-Fang model, they illustrate how an expert system coupled with computer graphics and augmented with remote sensing can enhance the process of decision making in hazardous waste site investigations. This combined system can integrate diverse sources of knowledge, reason heuristically with incomplete and imprecise data, accept data and advice continuously as they become available, and display useful information and the level of knowledge used during the process of the investigations. The present paper describes a prototype system, and presents the important aspects of GEOTOX for knowledge representation, types of rules and facts used in the knowledge base, the problem-solving strategy and assumptions used in the inference mechanism, and the basic features of the use-system interface. (See also W87-00832) (Lantz-PTT)
W87-00858

REMOVAL OF CADMIUM FROM CONTAMINATED GROUNDWATERS THROUGH CO-PRECIPITATION AND ADSORPTION IN LIME SOFTENING OPERATIONS,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-00863

AEROBIC BIODEGRADATION OF LEACHATE AND FORCED EXTRACTS FROM A SLUDGE DISPOSAL LAGOON,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5E.
W87-00866

RESERVOIR SITE PREPARATION: SUMMARY REPORT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects Lab.
For primary bibliographic entry see Field 2H.
W87-00870

GENERAL GUIDELINES FOR MONITORING CONTAMINANTS IN RESERVOIRS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. B. Waide.
Available from the National Technical Information Service, Springfield, VA. 22161. Instruction Report E-86-1, February 1986. Final Report. 172 p, 10 tab, 87 ref.

Descriptors: *Monitoring, *Water pollution, *Reservoirs, *Water quality management, Water quality control, Standards, Statistical analysis, Water sampling, Water analysis, Data acquisition, Data analysis.

This report provides general guidance to Corps of Engineer Division and District personnel on the design and conduct of programs for monitoring chemical contaminants in reservoir waters, sediments, and biota. The report is organized based on eight areas of consideration in conducting a reservoir contaminant monitoring program: (a) historical water quality concerns in Corps reservoirs, statutes relevant to reservoir management, and existing contaminant problems in Corps reservoirs; (b) selection of variables to be monitored; (c) design of the sampling program, including location and frequency of sampling and statistical considerations; (d) sampling methods and quality assurance procedures; (e) analytical methods; (f) procedures for management of monitoring programs conducted under contract; (g) management and processing of data; and, (h) data interpretation, including statistical considerations and compliance with regulatory criteria and standards. It is emphasized that the general recommendations provided in the report must be tailored to the design, morphometry, and operation of a specific reservoir and the specific contaminant problems that are known or suspected to occur there. (Author's abstract)
W87-00871

INTERIM GUIDANCE FOR PREDICTING THE QUALITY OF EFFLUENT DISCHARGED FROM CONFINED DREDGED MATERIAL DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. R. Palermo.
Available from the National Technical Information Service, Springfield, VA. 22161. Miscellaneous Paper D-86-1, February 1986. Final Report. 36 p, 4 tab, 15 ref.

Descriptors: *Dredge spoil disposal, *Water pollution control, *Water quality control, *Effluents, *Dredging, Water quality management, Adsorption, Ion exchange, Dissolved solids, Particulate matter, Waste disposal, Sedimentation, Total dissolved solids.

The quality of effluent from confined dredged material disposal sites (water discharged during active disposal operations) is an environmental concern when the sediments to be dredged are contaminated. Dredged material placed in a confined disposal area settles, while the clarified supernatant waters with some residual colloidal solids are discharged from the site as effluent. The effluent may contain concentrations of both dissolved and particle-associated (adsorbed or attached by ion exchange) contaminants. A large portion of the total contaminant concentration is, however, particle associated. A modified elutriate test procedure to estimate both the dissolved and particle-associated concentrations of contaminants in confined disposal area effluents is discussed. The laboratory test simulates contaminant release under conditions prevalent in confined disposal areas and reflects: (1) sedimentation behavior of dredged material, (2) retention time of the containment, and (3) physicochemical environmental in ponded water during active disposal. In the test, sediment and water from the dredging site are mixed to a slurry concentration equal to the expected influent concentration under field conditions. The mixed slurry is aerated in a 4-liter cylinder for 1 hr to ensure oxidizing conditions will be present in the supernatant water. Following aeration, the slurry is allowed to settle under quiescent conditions for a period equal to the expected mean field retention time, up to a maximum of 24 hr. A sample is then extracted from the supernatant water and analyzed for total suspended solids, and for dissolved and total concentrations of contaminants of interest. The contaminant fractions of the total suspended solids may then be calculated. Column settling tests, similar to those used for design of disposal areas for effective settling, are used to define the concentration of suspended solids in the effluent for a given operational condition, i.e. ponded area, depth, and inflow rate. Using results from both of these analyses, a prediction of the total concentration of contaminants can be made. The acceptability of the proposed confined disposal operation can be evaluated by comparing the predicted contaminant concentrations with applicable water quality standards while considering an appropriate mixing zone and the quality of the receiving water body. (Lantz-PTT)
W87-00880

FIRST CANADIAN/AMERICAN CONFERENCE ON HYDROGEOLOGY: PRACTICAL APPLICATIONS OF GROUND WATER GEOCHEMISTRY.
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 2F.
W87-00892

SAMPLING AND ANALYSIS OF SUBSURFACE WATER,
For primary bibliographic entry see Field 5B.
W87-00899

CURRENT STATUS OF WATER QUALITY IN LONG, JOHANNA AND JOSEPHINE LAKES - A SUMMARY REPORT ON THE DETAILED EVALUATION OF THE LONG LAKE CHAIN OF LAKES IMPROVEMENT PROJECT,
Environmental Research Group., Inc., St. Paul, MN.
H. M. Runke, and J. Shapiro.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-173856, Price codes: A09 in paper copy, A01 in microfiche. Report EPA-600/3-83-008, March 1983. 104 p, 43 fig, 19 tab, 22 ref. USEPA Grant R805681010.

Descriptors: *Water quality control, *Lake restoration, Long Lake, Johanna Lake, Josephine Lake, Minnesota, Phosphorus, Monitoring, Nutrients, Hydrologic budget, Nitrogen, Phytoplankton, Zooplankton, Aquatic plants, Sediments, Lake sediments.

The hydrologic budget and water quality of Long, Johanna, and Josephine Lakes, Minnesota, were monitored for three years starting in February 1978. These lakes receive agricultural and urban runoff, resulting in poor water quality, flooding, creek bed erosion, and substantial sediment transport. Several water quality improvement projects were constructed during 1979. These consisted of a berm to increase storage capacity and filtration time in the wetlands south of Long Lake, a new outlet structure at Lake Johanna to increase discharge capacity during storms, streambank stabilization on lake tributaries, diversion of stormwater from Lake Josephine to a nearby marsh, a sedimentation basin upstream of Long Lake, and dredging of Long Lake. Data are given for phosphorus, chlorophyll a, Secchi disc transparency, nitrogen, phytoplankton, macrophytes, zooplankton, hydrologic budget, sediment phosphorus release, and enrichment experiments. Since only a part of the planned lake restoration work was completed during the term of the study, data were considered insufficient to describe a response. However, a model was constructed to predict the change in average summer chlorophyll a concentration from the summer phosphorus concentration. (Cassar-PTT)
W87-00955

OPPORTUNITIES FOR MINIMIZING IMPACT OF AGRICULTURAL CHEMICALS ON ESTUARINE PRODUCTIVITY,
National Audubon Society, Washington, DC.
M. K. Himkle.
IN: Proceedings of the Workshop on Agrichemicals and Estuarine Productivity, Duke University Marine Laboratory, Beaufort, North Carolina, September 18-19, 1980. December 1982. p 273-280, 14 ref.

Descriptors: *Water quality control, *Estuaries, *Water pollution effects, *Pesticides, *Legislation, Toxaphene, Insecticides, Monitoring, Toxicity, Agricultural chemicals.

The use of pesticides is controlled by legislation and other regulations. Sophisticated tests are required before a chemical is introduced to the market for a particular use and before reregistration. However, the synergistic, chronic, and long-term effects are often difficult or impossible to document. Although more comprehensive monitoring is desirable, funds for this are declining and sampling programs are years behind schedule. Toxaphene is an example of how a compound, once on the market, can expand despite demonstrated adverse effects, long-term toxicity, and strenuous objections by governmental agencies. Some alternative pest management strategies presently being promoted are cultural methods, pest-specific diseases, resistant crop varieties, sterile insects, attractants, and augmentation of parasites or predators. (See also W87-00957) (Cassar-PTT)
W87-00969

PAYING THE TAB FOR CLEAN WATER,
A. D. Blessing, and L. Henderer.
Chemical Week, Vol. 139, No. 1, p 13-14, July 2, 1986.

Descriptors: *Cost analysis, *New York, *Legislation, *Liability, *Pesticides, Aldicarb, Long Island, Hazardous Waste Remedial Fund, Farm Bureau, National Coalition Against Misuse of Pesticides.

A bill in the New York State Legislature, supported by the New York Farm Bureau, would limit the liability of farmers for pesticide contamination of groundwater. The effect would be to shift liability to pesticide manufacturers. No farmer has been held liable yet, but one suit is in preparation, and the effect of lawsuits against farmers resulting from such incidents as the aldicarb contamination of 1,000 wells on Long Island could be 'devastating' to New York farmers according to Assemblyman Richard I. Coombe, a sponsor of the bill. The proposed legislation would establish a groundwater indemnification account within the Hazardous Waste Remedial Fund consisting of 30 million dollars. The National Agricultural Chemicals Association and the National Coalition Against Misuse of Pesticides oppose eliminating the farmer's responsibility for careful use of pesticides. (Rochester-PTT)
W87-01042

EPA BROADENS ITS LIST OF HAZARDS,
L. A. Rich.
Chemical Week, Vol. 139, No. 1, p 26-27, July 2, 1986. 1 tab.

Descriptors: *Environmental Protection Agency, *Hazardous materials, *Pollutants, *Administrative regulations, Resource Conservation and Recovery Act, Extraction Procedure Toxicity Characteristic, Landfills, Groundwater pollution, Water quality standards.

The Environmental Protection Agency (EPA) is seeking to expand significantly the list of chemicals that are designated as hazardous under the 1984 amendments to the Resource Conservation and Recovery Act (RCRA). A regulation proposed by EPA in the June 13 Federal Register would add 38 organic compounds to the list of 14 substances EPA uses in one of its tests to identify wastes as hazardous and earmark them for management under RCRA. The proposed the rule also would amend the identification test, the Extraction Procedure Toxicity Characteristic, by adding models to account for the mobility of and dilution of compounds as they migrate from landfills to groundwater. The reasons for these changes are reported, the proposed 52 toxicity characteristic contaminants are listed, and the economic impact of the proposed regulations is discussed. (Rochester-PTT)
W87-01043

AIR, LAND, WATER ANALYSIS SYSTEM (ALWAS): MULTI-MEDIA PATHWAYS OF ORGANIC POLLUTANTS IN FRESHWATER SYSTEMS,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5B.
W87-01045

HIGH-STAKES WATER QUALITY SUIT IN TEXAS,
M. Lawson, and L. A. Rich.
Chemical Week, Vol. 138, No. 26, p 79-80, June 25, 1986.

Descriptors: *Environmental Protection Agency, *Lawsuits, *Texas Water Commission, *Water quality standards, General Accounting Office, Law enforcement, Clean Water Act.

The participants and possible consequences are outlined of a lawsuit brought against the Environmental Protection Agency (EPA) in federal court by a group of environmental groups. The plaintiffs assert that the EPA has failed to set tougher water quality standards for Texas under the Clean Water Act. They say that the agency is obligated to do so because the Texas Water Commission (TWC) has not done so. A General Accounting Office report citing more than 3,000 discharge sources with neither state or federal permits and noncompliance by 75% of dischargers who do have permits has been submitted as proof of EPA's failure to act. The response of the TWC, Texas industries, and the situation in municipal wastewater discharges, where 14 lawsuits against municipalities have been initiated by EPA, are discussed. (Rochester-PTT)
W87-01098

INGESTION AND ASSIMILATION OF ALGAE BY NAIS ELINGUIS (OLIGOCHAETA: NAIDIDAE),
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 4A.
W87-01145

POLLUTER PAYS PRINCIPLE - WHO IS REALLY PAYING,
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
N. Deering, and N. F. Gray.
Effluent and Water Treatment Journal EWTJAG, Vol. 26, No. 5/6, p 138-142, May 1986. 2 fig, 5 tab, 13 ref.

Descriptors: *Pollution control, *Effluent treatment cost, *Water pollution control, Water quality, Europe, Pollution, Water treatment.

The concept of charging for the treatment of industrial effluents by municipal authorities in Western Europe dates back some seventy years. It was introduced in Germany by the Ruhreinhaltgesetz in 1913 and since then has been adopted by most Western European countries. In 1972, the Organization for Economic Co-operation and Development (OECD) recommended that the Polluter Pays Principle (PPP) should be the fundamental mechanism for the allocation of costs incurred by local authorities in the prevention of pollution and carrying out of pollution control measures. The PPP ensures that effluent disposal and treatment costs are taken into account by manufacturers in the overall production costs, so that cost of the final product reflects the true cost of production. However, little comparative information is available because different methods of charging for effluent treatment operate in each country. Two distinct types of charge exist. (1) effluent charges are levied by local authorities for discharges directly to surface water and (2) user charges levied for the use of the authority's collective treatment system. Trade effluent treatment charges by municipal authorities in five European countries, were compared. The range of treatmnent costs varies considrably between municipal authorities within each country. The largest ranges occurred in Holland for all the industries examined except for the dairy industry, where the largest was found in England and Wales. No significant differences were found between average treatment costs in England and Wales. However significant differences existed between the average treatment costs in France and Ireland and the estimated industrial treatment costs. Many difficulties exist in comparing trade effluent treatment charging systems. It would appear that local authorities in Holland, West Germany, England and Wales come close to charging the actual industrial treatment costs for the seven effluents examined, although in some cases the charges appear to be excessively high; the local authorities in France and Ireland appear to be levying charges significantly below the actual cost of treatment. Whether this should be considered as a form of subsidy to industries in these countries is not clear, however it would appear that the polluter pays principle as defined by the OECD does not apply to waste treatment charges levied in either France or Ireland. (Khumbatta-PTT)
W87-01204

FUTURE TRENDS IN ATMOSPHERICALLY INDUCED ACIDIC DEPOSITION,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. R. Kramer.
Experientia EXPEAM, Vol. 42, No. 5, p 517-520, May 15, 1986. 2 fig, 13 ref.

Descriptors: *Prediction, *Acid rain, *Air pollution, *Ecosystems, *Water pollution control, Planning Rainfall, Air pollution effects, Water pollution prevention, Water quality management, Economic aspects, Legal aspects, Regulations.

Possible framework are discussed within which future trends may be considered regarding the environmental problems that will result from emissions of oxides of sulfur and nitrogen. The conceptual base must be carefully examined because the scale of the assessment is very large in space (global) and in time (decades). These scales require analyses of the entire ecosystem, including social-economic-political structures. The paper develops the concept of a major ecosystem experiment (including man) of past human perturbations of the ecosystem. Examples are presented for past trends, recent spatial trends, and possible future trends. In order to assess possibilities as well as ecosystem

sensitivities, emissions estimates should be made for different sub-categories of societal uses, and these estimates should be evaluated particularly for price and consumer reaction sensitivity. Continuing evaluation and assessment of impacts should result in decreased emissions and a more flexible system responsive to future uncertainties. (Doria-PTT)
W87-01214

INTERVENTION ANALYSIS OF POWER PLANT IMPACT ON FISH POPULATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 6G.
W87-01247

ARE THE 'GUIDELINES FOR DERIVING NUMERICAL NATIONAL WATER QUALITY CRITERIA FOR THE PROTECTION OF AQUATIC LIFE AND ITS USES' BASED ON SOUND JUDGMENTS,
Environmental Research Lab.-Duluth, MN.
C. E. Stephan.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 515-526. 2 tab, 21 ref.

Descriptors: *Water quality, *Water quality standards, *Toxicity, *Aquatic life, Environmental protection, Bioaccumulation, Hazardous materials, Biological magnification, Water pollution effects.

Until recently, procedures used to derive water quality criteria for aquatic life were not well defined and few principles were identified. On November 28, 1980, the United States Environmental Protection Agency published 'Guidelines for Deriving Water Quality Criteria for the Protection of Aquatic Life and Its Uses' in the Federal Register. These guidelines have been subsequently revised and renamed 'Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Life and Its Uses' and are referred to as the 'National Guidelines'. In addition, guidelines have been developed for deriving site-specific criteria either by modifying national criteria or by using other appropriate information. Procedures for deriving water quality criteria and for assessing hazard to aquatic life have many similarities because both make use of data from many areas of aquatic toxicology and both assume that the science has developed sufficiently that these activities are feasible and desirable for making decisions concerning various technical issues. The new guidelines incorporate the concept of required data and define the concept of protection to include the protection of aquatic life and its uses. The Guidelines use the two-number criteria for the discharge of hazardous effluents and acute-chronic ratios in place of application factors. The Guidelines could be strengthened considerably by requiring more data for calculation of the Final Residue Value. Bioaccumulation factors, rather than bioconcentration factors could be required and where available, data on toxicity to wildlife should be used. (Geiger-PTT)
W87-01321

HOW REPRESENTATIVE ARE THE DATA SETS USED TO DERIVE NATIONAL WATER QUALITY CRITERIA,
EA Engineering, Science, and Technology, Inc., Northbrook, IL.
G. Seegert, J. A. Fava, and P. M. Cumbie.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 527-537. 4 fig, 2 tab, 13 ref.

Descriptors: *Toxicity, *Data collections, *Water quality standards, *Water pollution, Water pollution effects, Aquatic animals, Hazardous materials, Data interpretation, Water quality.

Evidence is presented to show that the data sets used to derive the national water quality criteria may not be representative of the population as a whole. Examination of the national toxicity data base showed that for 21 priority pollutants, 40% of the data are on a few regularly tested species such as bluegill and fathead minnow, and one quarter of the data are on only two families, Daphnidae and Salmonidae. For many chemicals, many of the species that have been tested are restricted to the northeastern and/or upper midwest portions of the United States. Toxicity data for some of the commonly tested species are often replicated and verified by several investigators, whereas data on other species are not. In addition, sensitive species may be overrepresented in the national toxicity data base. Because of these misrepresentations, the data base contains a great deal of data about a few species, but little or no data about the vast majority of species. In order for the data base to be representative of the full range of sensitivities expected in the population as a whole, more information is needed on a wider variety of organisms that represent a reasonable cross section, based on sensitivities or ecological importance. (Geiger-PTT)
W87-01322

AQUATIC HAZARD EVALUATION PRINCIPLES APPLIED TO THE DEVELOPMENT OF WATER QUALITY CRITERIA,
Monsanto Co., St. Louis, MO.
R. A. Kimerle, A. F. Werner, and W. J. Adams.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 538-547. 5 tab, 10 ref.

Descriptors: *Toxicity, *Bioassay, *Water quality standards, Hazardous materials, Data collections, Aquatic animals, Daphnia, Bluegills, Fathead minnows, Trout, Water pollution effects.

The methodology to derive a national water quality criterion requires that the acute toxicity data base contain at least eight species from eight families. The thesis investigated here is that for many chemicals, fewer species acute toxicity tests are adequate for deriving criteria and for screening chemicals to determine whether a criterion is necessary. This is especially true when the exposure concentration is expected or known to be several orders of magnitude below the acute effect concentration. An 82 chemical acute toxicity data base with an average of 9.5 species acute toxicity tests per chemical was reviewed for the relationship between the most sensitive species LC50 value and LC50 values for four of the most commonly tested species: Daphnia, fathead minnow, bluegill, and rainbow trout. It was concluded that for 90% and 98% of the 82 chemicals reviewed, the Daphnia and fathead minnow acute data were within one and two orders of magnitude, respectively, of the most sensitive species. The ability to predict the LC50 for the sensitive species is improved if three species are used; 98% of the LC50s are included with Daphnia, fathead minnow, and bluegill and 93% with algae, Daphnia, and fathead minnow. Therefore it was concluded that for many chemicals, acute tests with only two or three species are enough to determine that a water quality criterion is not needed for the chemical. (Author's abstract)
W87-01323

ROLE OF PHYTOTOXICITY TESTS IN THE DERIVATION OF NUMERICAL NATIONAL WATER QUALITY CRITERIA,
Illinois State Water Survey, Peoria. Water Quality Section.
W. Wang.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, PA, 1985, p 548-550. 2 fig.

Descriptors: *Bioassay, *Toxicity, *Phytotoxicity, *Water quality standards, Water quality, Water pollution effects, Assay, Ecological effects, Sensitivity analysis.

The National Guidelines for Numerical National Water Quality Criteria incorrectly assumes that concentrations of a hazardous material which will not cause unacceptable adverse effects on animals will also not unacceptably affect plants. This assumption ignores the possibility that phytotoxicity tests may not be as sensitive or well developed as animal tests to detect toxicity. A more objective approach for the National Guidelines to take would be to encourage further studies so that a better assessment could be made of the phytotoxic effects of a substance when more results are available. (Geiger-PTT)
W87-01324

EVALUATION OF A SITE-SPECIFIC WATER QUALITY CRITERION FOR PENTACHLOROPHENOL USING OUTDOOR EXPERIMENTAL STREAMS,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
S. F. Hedtke, and J. W. Arthur.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 551-564, 1 fig, 3 tab, 17 ref.

Descriptors: *Water quality standards, *Phenols, *Phenolic pesticides, *Water pollution effects, *Aquatic animals, Snails, Fish, Phytoplankton, Ecosystems, Aquatic life, Ecological effects, Bioassay, Toxicity, Streams, Chlorinated hydrocarbons.

An overview of a study to evaluate a site-specific water quality criterion for pentachlorophenol (PCP) in outdoor experimental streams is presented. The site-specific criterion was calculated from acute toxicity results for eight resident species and the relationship between acute and chronic toxicity of PCP. The PCP concentration expected to protect aquatic life (30-day average criterion concentration) was less than or equal to 48 micrograms/L. Outdoor experimental streams were subsequently dosed continuously for 84 days at 48, 144, and 432 micrograms PCP/L. Measurements of the biological structure and ecosystem processes within the exposure streams were compared to a control system. Effects on snails were found only at 432 micrograms/L, but effects on fish, periphyton, and system metabolism were found at 432, 144, and 48 micrograms/L. The small differences between the criterion-dosed stream (48 micrograms/L) and the control stream may have been caused by PCP or interstream variation. The acceptability of this criterion concentration depends in part on the definition of protection of aquatic life and its uses. (Author's abstract)
W87-01325

USE OF STATISTICAL INFORMATION TO IMPROVE COMPATIBILITY BETWEEN THE VARIOUS COMPONENTS OF THE WATER QUALITY BASED APPROACH,
Environmental Research Lab.-Duluth, MN.
N. A. Jaworski, and D. I. Mount.
In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, American Society for Testing and Materials, Philadelphia, 1985, p 565-573. 10 ref.

Descriptors: *Toxicity, *Water quality standards, *Aquatic animals, *Wastewater management, Bioassay, Statistical methods, Wastewater treatment, Water quality, Waste management, Aquatic life, Environmental protection, Ecological effects, Water pollution, Water pollution effects, Environmental effects.

During the past two decades, implementation procedures in wastewater management often resulted in a large margin of safety being incorporated into the use of water quality criteria for the protection of aquatic life and its uses. Wasteload allocation design conditions, such as the use of seven-day, ten-year low flow, gave assurances of instream concentrations well below the water quality criteria a large percentage of time. Present-day economic conditions and the increasing cost of advanced wastewater treatment are necessitating a re-examination of how water quality criteria are being used in the water quality based approach for establishing effluent limitations. The relationships between water quality criteria and other components of the water quality based approach are identified. The need for a better defined and more consistent use of statistical information is suggested

not only in the development of water quality criteria but also for the entire water quality based approach. Intensity, duration, and frequency of occurrence (return period) appear to be three common statistical parameters of the six-step water quality based approach. Research is identified which, if successful, would allow water quality managers better insight in determining pollutant exposures that more adequately simulate receiving water conditions resulting from variable stream flows, wastewater discharge rates, and pollutant concentrations. (Author's abstract)
W87-01326

USE OF HOT WATER DISCHARGED BY THE FESSENHEIM NUCLEAR POWER PLANTS FOR FOREST PRODUCTION, (UTILISATION DES EAUX CHAUDES REJETEES PAR LES CENTRALES NUCLEAIRES DE FESSENHEIM EN VUE D'UNE PRODUCTION SYLVICOLE),
Centre de Recherches de Colmar (France). Station d'Agrooomie.
For primary bibliographic entry see Field 3C.
W87-01332

PROBLEMS OF MODELING SEEPAGE AND MASS TRANSPORT FOR PURPOSES OF PROTECTING GROUNDWATERS FROM POLLUTION,
A. Y. Oleinik.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 334-339, January 1986. 22 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Model studies, *Seepage, *Mass transfer, *Groundwater, *Groundwater pollution, *Water pollution control, Subsurface water, Water, Water pollution, Water pollution sources, Hydrodynamics, Path of pollutants.

The theoretical basis and construction of mathematical models for protecting groundwaters from various pollutants is considered, along with desalination of saline soils and artificial recharge methods. Hydrodynamic aspects include migration of pollutants and salts, seepage of solutions, and interaction between liquid and solid phases, involving such processes as molecular and convective diffusion, sorption and desorption, ion exchange, dissolution and crystallization, and chemical reactions. These problems are discussed and equations provided. (Doria-PTT)
W87-01394

ROLE OF GROUNDWATER IN DELAYING LAKE ACIDIFICATION,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W87-01450

FREQUENCY DOMAIN ANALYSIS OF GROUNDWATER QUALITY FLUCTUATIONS: INTERPRETATION OF FIELD DATA,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-01452

SIMPLE AND INEXPENSIVE MONITOR FOR RECORDING OXYGEN AND TEMPERATURE IN LAKES AND RESERVOIRS,
King's Coll., London (England). Dept. of Human Environmental Science.
For primary bibliographic entry see Field 7B.
W87-01469

WATER QUALITY MONITORING IN THE STATE-MANAGED WATERS OF THE NETHERLANDS,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands). Surface Water Branch.
B. G. M. v.d. Wetering, and S. Groot.
Water Research WATRAG, Vol. 20, No. 8, p 1045-1050, August 1986. 5 fig, 10 ref.

Descriptors: *Water quality control, *Monitoring, *Water management, *Netherlands, Management planning, Research priorities, Cost analysis, Optimization, Model studies.

The monitoring program of the state-managed waters of The Netherlands, was revised in 1981 and 1982. A review of the criteria and boundary conditions that played an important role in this revision is presented, following by a description of the present monitoring program. The costs involved in monitoring the water quality are high. In order to determine a quantitative relationship between the monitoring effort and the effectivity of the obtained information, research for the optimization of this effort started in 1979. The results of the optimization of the sampling frequency of the monitoring program are presented. Research needed to fill the gaps in the available knowledge and to optimize monitoring programs is suggested. The largest short-range benefit is expected to come from optimization of the sampling locations, especially if combined with optimization of the sampling frequency. Water quality models will play an important role in optimization efforts. (Peters-PTT)
W87-01475

MODELS TO MINIMIZE MONITORING,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 7A.
W87-01477

CAPTURE-ZONE TYPE CURVES: A TOOL FOR AQUIFER CLEANUP,
Lawrence Berkeley Lab., CA. Earth Sciences Div.
I. Javandel, and C. -F. Tsang.
Ground Water GRWAAP, Vol. 24, No. 5, p 616-625, September-October, 1986. 9 fig, 1 tab, 5 ref. EPA Contract No. DW 89930722-01-0 and DOE Contract DE-AC03-76SF00098.

Descriptors: *Aquifers, *Cleanup operations, *Graphical analysis, *Groundwater pollution, *Water pollution treatment, Injection, Mathematical analysis, Pump wells.

A common method of aquifer cleanup is to extract the polluted groundwater after reducing the concentration of contaminants in the water below a certain level, the treated water is either injected back into the aquifer, or if it is environmentally and economically feasible, released to a surface-water body. The proper design of such an operation is very important, both economically and environmentally. A method was developed which can assist in the determination of the optimum number of pumping wells, their rates of discharge and locations, such that further degradation of the aquifer is avoided. The complex potential theory has been used to derive the equations for the streamlines separating the capture zone of one, two, or more pumping wells from the rest of the aquifer. A series of capture-zone type curves are presented which can be used as tools for the design of aquifer cleanup projects. The use of these type curves is shown by an hypothetical field case example. (Author's abstract)
W87-01493

PROTECTING THE CHESAPEAKE BAY: MARYLAND'S CRITICAL AREA PROGRAM,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
A. Powers.
Environment ENVTAR, Vol. 28, No.4, p 5, 44-45, May 1986. 3 ref.

Descriptors: *Chesapeake Bay, *Estuaries, *Maryland, Water quality, Water pollution, Chesapeake Bay Foundation, Pollution.

The Chesapeake Bay is a unique and valuable natural resource. North America's largest estuary, it stretches 200 miles from the Susquehanna River in the north to Cape Charles, Virginia, in the south. The introduction of too many nutrients, sediments, and toxic compounds has led to a decline in water quality and species diversity. A number of key 'Chesapeake Bay Initiatives', were set up, one of which was the Critical Area Act. The act deals with land use and the effect of development on habitat and water quality. The Critical Area Act set forth three goals: to minimize adverse impacts on water quality from activities on land; to conserve fish, wildlife,and plant habitats; and to establish land-use policies for development in the Critical Area. The Critical Area Program is unique in the Chesapeake Bay region, and is one of only a handful of similar legislative efforts throughout the country. For its part, the Chesapeake Bay Foundation (CBF) has initiated a project to monitor the implementation of the Critical Area Act and to promote similar programs in othe bay states. Maryland has taken the lead in attempting to control and minimize the effect of population pressure and development activities in the Chesapeake Bay basin. Maryland's efforts should be viewed as the initial move toward comprehensive land-use planning for the bay. (Khumbatta-PTT)
W87-01503

EC PROPOSAL FOR A COUNCIL DIRECTIVE ON WATER QUALITY OBJECTIVES FOR CHROMIUM,
Anglian Water Authority, Huntingdon (England).
P. J. Matthews.
Effluent and Water Treatment Journal, EWTJAG, Vol. 26, No. 5/6, p 176-178, June 1986. 3 append, 4 ref.

Descriptors: *European Council, *Water quality, *Chromium, *Heavy metals, Water quality data, Impaired water quality, Water, Hazardous material, Pollution.

The 1976 Directive on pollution caused by certain dangerous substances discharged into the aquatic environment, divided these dangerous substances into two lists. The first of these is the so-called black-list (List I) of highly dangerous substances. The Directive stipulates that limit values for the discharge of these substances into the water environment and environmental quality objectives must be established as soon as possible. The second list (List II) is the grey-list of less dangerous substances and chromium is one of these. Member States were called upon to develop national pollution reduction programs and to define EQS values and to submit these to the European Council. Chromium, which is widely used in leather processing, metallurgy and engineering is the first of the substances on the grey-list for which Member States have drawn up programs first of the substances on the grey-list for which Member States have drawn up programs. (Khumbatta-PTT)
W87-01516

CLEAN-UP IN THE ROCKIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
D. W. Thompson, E. W. Berry, and B. L. Anderson.
Civil Engineering (ASCE), Vol. 56, No. 2, p 40-42, February 1986. 2 fig.

Descriptors: *Water pollution treatment, *Water contamination, *Groundwater pollution, *Groundwater contamination, *Rocky Mountain Arsenal, *Pollutants, Dibromochloropropane, Subsurface water.

The Rocky Mountain Arsenal occupies over 17,000 acres in Adams County, Colorado. The property was used throughout the Second World War for the manufacture and assembly of chemical intermediate and toxic end-item products and incendiary munitions. From 1950 to 1969, GB nerve agent munitions were produced or filled on the site. The arsenal since then has been used primarily for the caustic neutralization and incineration of chemical warfare material. In the early 1970's, contaminants were found to be migrating across the arsenal's north and northwest boundaries. To intercept contaminants migrating from the arsenal's north boundary, a pilot groundwater contamination control systsem was constructed in 1977. The project consisted of a slurry wall barrier made with a mixture of soil and bentonite clay. Six

dewatering wells were installed upgradient of the barrier, and thirteen recharge wells were placed north of the wall. The pilot project verified the effectiveness for removing diisopropylmethyl phosphonate (DIMP). But a new contaminant, dibromochloropropane (DBCP) was discovered in the arsenal's groundwater. Some mechanical problems were encountered during the first couple of years of operation. In general, the systems have worked effectively in removing all contaminants, and the arsenal is fast becoming a proving ground, not for weapons, but for clean-up techniques. (Khumbatta-PTT)
W87-01519

CLEANING UP TOXICS,
R. Robison.
Civil Engineering (ASCE) Vol. 56, No. 2, February 1986, p 46-49, 1 fig.

Descriptors: *Toxicity, *Water pollution treatment, *Toxic wastes, *Hazardous materials, *Contaminant liquids, Poisons, Waste matters, Spills, Sludge, Pollution, Saturated tailing fines, Volatile organics.

Cleaning up toxic wastes and spills is not an easy task, but progress is being made, site by site, across the U.S. Time, money and engineering skill are all that are required to clean up toxic wastes. No one seemed to have realized just how much time and money, this clean up would take. Even with the rapidly developing technology, site cleanups are still being measured in years and millions of dollars. New detection devices and computer analysis programs can speed identification of toxics in soil and groundwater. Cutoff and sealing technologies make containment possible. When soils containing hazardous wastes are disposed of according to RCRA regulations, even the wastewater generated by decontamination of equipment may have to be handled as hazardous waste. (Khumbatta-PTT)
W87-01520

COMPUTER PROGRAM FOR THE TOXICITY AND PERMISSIBLE DISCHARGE DETERMINATION OF INDUSTRIAL EFFLUENTS,
National Environmental Engineering Research Inst., Nagpur (India).
N. J. Kumar, and K. P. Krishnamoorthi.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 3, p 225-231, November 1985. 2 tab, 16 ref.

Descriptors: *Computer programs, *Toxicity, *Water quality standards, *Effluent limitations, *Industrial wastewater, Water quality control, Bioassay, Computers, Wastewater, Effluents, Fish.

A simple computer program is described for calculating the toxicity of industrial effluents based on log-logit model. The program is written in BASIC II, which is commonly used and can be run on most microcomputers by most of the wastewater treatment operators. Parameters incorporated include LC50, 95% confidence intervals, intercept, logit slope, and correlation coefficient. The essential feature of this program is to measure tolerance distributions that produce a sigmoid appearance of their correspondence dose-response function for extrapolation studies to estimate dose level at a desired level of response within a single test organism. Calculation of in-stream waste concentration to determine whether the particular effluent needs to be pretreated or not is also included in the program based on the Biomonitoring protocol developed by the National Pollutant Discharge Elimination System (NPDES). A sample test run with actual data is presented along with the user's response to questions for the example of aniline plant effluent. (Doria-PTT)
W87-01569

PRODUCTION QUOTIENT PQ: A NEW APPROACH FOR QUALITY DETERMINATION OF SLIGHTLY TO MODERATELY POLLUTED RUNNING WATERS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5A.
W87-01601

FOURTH NATIONAL SYMPOSIUM AND EXPOSITION ON AQUIFER RESTORATION AND GROUND WATER MONITORING.
National Water Well Association, Worthington, OH.
Available from the National Water Well Association, 500 W. Wilson Bridge Road, Worthington, OH. 43085. Price: $35.00. May 23-25, 1984. The Fawcett Center, Columbus, Ohio. Edited by David M. Nelson and Mary Curl. 401 p.

Descriptors: *Aquifer management, *Groundwater pollution, *Monitoring, *Information exchange, Water quality control, Geophysics, Groundwater contamination, Water pollution treatment.

Government officials, consulting engineers, hydrogeologists, geophysicists and geologists, researchers, industry representatives and other interested persons met to learn and discuss state-of-the-art techniques employed in performing groundwater investigations using both surface and borehole geophysical methods. Additionally, the latest in state-of-the-art instrumentation was discussed and displayed. The conference provided a forum for all who attended to communicate and share their experiences in the rapidly developing field of hydrogeophysics. Subjects covered during this meeting included: surface electrical methods in groundwater exploration; gravimetric and seismic methods in groundwater exploration; integrated programs for groundwater exploration; surface electrical methods in groundwater contamination investigations; integrated programs for groundwater quality investigations; magnetic methods to delineate zones of contamination; borehole geophysical methods for identifying aquifer characteristics; and borehole geophysical methods for characterizing hazardous waste sites and contaminant plumes. These proceedings are a compilation of papers presented by the symposium speakers. (See also W87-01670 thru W87-01716) (Lantz-PTT)
W87-01669

DESIGN AND EVALUATION OF IN-PLACE CONTAINMENT STRUCTURES UTILIZING GROUND WATER CUTOFF WALLS,
E. R. Lynch, S. W. Anagnost, G. A. Swenson, and R. K. Goldman.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 1-7, 2 tab, 8 ref.

Descriptors: *Design standards, *Cutoff walls, *Containment structures, *Groundwater pollution, Water quality control, Cutoffs, Bentonite, Cements, Slurries.

Groundwater cutoff walls are an effective method of restricting the flow of groundwater or contaminants. There are a variety of materials (bentonite, bentonite slurries, soil-bentonite, and cement bentonite) and methods available for constructing a groundwater cutoff wall. Selection of a type of groundwater cutoff wall should be based on a number of criteria specific to each job. Prior to installation, a laboratory testing program should be undertaken to ensure that the selected cutoff wall material will successfully restrict the flow of groundwater or contaminants. An evaluation of the post-construction groundwater hydraulics should be conducted to assess the impact of cutoff wall construction on the flow of groundwater or contaminants and the post-construction groundwater elevation. A field-testing program should be undertaken in order to insure that the groundwater cutoff wall materials are properly prepared and installed. Much more work is needed to determine the long-term effects of the chemicals being contained on the installed backfill materials to insure that the cutoff wall will contain the contaminants for a design period. Potential areas of investigation include migration by capillary action, electrical potential, surface reaction and neutralization and chemical corrosion breakdown. (See also W87-01669) (Lantz-PTT)
W87-01670

DESIGN OF SOIL-BENTONITE BACKFILL MIX FOR THE FIRST ENVIRONMENTAL PROTECTION AGENCY SUPERFUND CUTOFF WALL,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
D. Schulze, M. Barvenik, and J. Ayres.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 8-17, 10 fig, 4 ref.

Descriptors: *Water pollution control, *Bentonite, *Backfill, *Cutoff walls, *Groundwater pollution, *Superfund, Cutoffs, Chemical properties, Leachates, Water quality control, Temperature effects, Hydraulic properties, Chemical degradation, Hydraulic conductivity.

Laboratory testing programs utilized in the design of soil-bentonite backfill mixes require careful assessment of the physical conditions expected to exist in the completed cutoff wall as well as the chemical characteristics of the site leachate. Additional variables inherent in the procedures and materials used to construct the containment must also be accounted for. Testing can be performed that simultaneously models low stresses and gradient, temperature and the chemical nature of the permeant. A testing program was developed in 1981 to establish minimum criteria for the soil-bentonite backfill mixture specified on the Gilson Road project. This procedure utilized a large number of quick and inexpensive 'API' (fixed ring) hydraulic conductivity and unit weight tests to establish preliminary mix proportions. Two independent series of triaxial (flexible membrane) tests were then performed to determine separately, the effects of low stress/gradient and chemical degradation on hydraulic conductivity. The results were superimposed to evaluate the projected long-term performance of the backfill mix. Based on the testing and design protocol presented, the very coarse and permeable nature of the in situ soils at the Gilson Road site required the addition of off-site fines in order to cost-effectively achieve the specified hydraulic conductivity (not greater than 0.0000001 cm/sec). The final design mix specification required not less than 30% fines and 5% bentonite. Comparison of triaxial and long-term fixed ring data, appear to indicate that not only does the hydraulic conductivity of the intact sample (triaxial) increase with chemical permeation, but the backfill undergoes volumetric shrinkage. It is emphasized that data from the long-term testing are preliminary in nature and have not fully been analyzed. (See also W87-01669) (Lantz-PTT)
W87-01671

HYDROGEOLOGIC ASPECTS OF SLURRY WALL ISOLATION SYSTEMS IN AREAS OF HIGH DOWNWARD GRADIENTS,
E. A. Need, and M. J. Costello.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 18-26, 8 fig, 1 tab, 3 ref.

Descriptors: *Geohydrology, *Slurry walls, *Cutoff walls, *Isolation, *Water pollution control, *Groundwater pollution, Aquifers, Minnesota, Cutoffs, Slurries, Simulation analysis, Groundwater movement, Hydrocarbons, Phenols.

The application of slurry wall isolation systems to remediation of uncontrolled hazardous waste sites is becoming increasingly common. From the perspective of implementation, these systems are particularly suited to sites having a sandy surficial aquifer underlain by fine-grained deposits at depths of 60 feet or less. From the perspective of performance, however, site hydrogeologic conditions are the key determining factor. The impacts of high downward gradients on the performance of a slurry wall isolation system are illustrated for a site in Fridley, Minnesota. The Boise Cascade/Onan/Medtronics waste site is situated in the Anoka sandplain physiographic area, making it well-suited to slurry wall application. Forty years of wood-treating operations have resulted in soil and shallow groundwater contamination by polynucleated

aromatic hydrocarbons and phenols. Shallow groundwater flow is primarily horizontal through sandy glacial lake sediment, discharging to streams adjacent to the site. Due to high downward gradients, about 1 ft/ft, there is also some vertical flow through underlying fine-grained deposits - silty-clayey glacial lake sediment and fractured Grantsburg sublobe till - to a second drift aquifer. Installation of the cutoff walls interrupt normal lateral flow in the surficial aquifer without affecting the vertical gradients. Thus flow in the isolated area becomes essentially vertical. Due to the high vertical gradients and the large area encompassed by the isolation system (as compared to the wetted area of slurry wall itself), vertical flow out of the system temporarily exceeds horizontal flow in through the slurry walls, and the water level inside the isolation system will decline until equilibrium is re-established. Simulation of this process indicates that about three and a half years are required to naturally dewater the isolated part of the surficial aquifer, with equilibrium occuring somewhat later. In addition to preventing horizontal migration of the isolated contaminants in the surficial aquifer, the system greatly reduces the vertical contaminant flux and the total contaminant loading to the environment. (See also W87-01669) (Lantz-PTT)
W87-01672

SLURRY WALL INSTALLATION BY THE VIBRATED BEAM TECHNIQUE,
For primary bibliographic entry see Field 8A.
W87-01673

OPTIMIZING PUMPING STRATEGIES FOR CONTAMINANT STUDIES AND REMEDIAL ACTIONS,
Robert S. Kerr Environmental Research Lab., Ada, OK. Ground Water Research Branch.
J. F. Keely.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 33-43, 10 fig, 6 ref.

Descriptors: *Pumping, *Groundwater pollution, *Water pollution control, *Design criteria, *Plumes, Heterogeneity, Anisotropy, Aquifers, Flow rates, Pump wells, Physicochemical properties, Biotransformation, Contingency plans.

One of the more common techniques for controlling the migration of contaminant plumes is the use of pumping wells to produce desired changes in local flow rates and hydraulic gradients. When seeking to optimize an array of pumping well locations and discharge rates, it is important to consider the effects that non-ideal aquifer conditions, well construction and demographic constraints produce. Heterogeneous and anisotropic aquifer conditions seriously complicate siting and discharge rate requirements for pumping wells, because of the distorted cones of depression that result from withdrawing water in such settings. Proper screen selection, gravel pack emplacement and well development are crucial factors affecting the operational characteristics and economics of pumping wells. These factors are generally recognized though often undervalued. The impacts that well depth and diameter, and screen length and position have on the effectiveness of pumping efforts are also often undervalued, with detrimental consequences. Perhaps the most difficult problems to overcome in designing pumping schemes, however, are posed by demographic constraints. Denial of property access, vandalism and the unpredictability of nearby water supply and irrigation pumpage tend to wreak havoc with the best of pumping strategies. Other factors that have major impacts are the physicochemical attenuation and biotransformation potentials of the individual contaminant. It is not yet economically feasible to conduct adequately detailed studies of these potentials on a routine site-specific basis. Finally, a factor often overlooked that greatly impacts optimization efforts is the risk of mechanical and electrical operational failure. Adequate contingency plans must provide certain minimal levels of excess/reserve capacity and redundancy of key system components. The capture zones of wells do not equal their associated zones of pressure influence (cones of depression), except for stagnant aquifer conditions. Velocity distribution plots must be constructed to define potentials of contaminant migration. In particular, plotting the stream lines for various scenarios involving pumping and/or injection wells subject to a specific natural flow velocity can greatly assist the groundwater professional in selection of an optimal pumping strategy. (See also W87-01669) (Lantz-PTT)
W87-01674

HYDRODYNAMIC ISOLATION IN HAZARDOUS WASTE CONTAINMENT,
M. M. Ozbilgin, and M. A. Powers.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 44-49, 10 fig, 2 ref.

Descriptors: *Water pollution control, *Groundwater pollution, Cutoff walls, *Hazardous wastes, *Hydrodynamics, *Waste disposal, Flow rates, Graphical methods, Mathematical analysis, Computers, Model studies, Path of pollutants, Nashua, New Hampshire, Cutoffs, Pump wells, Burrillville, Rhode Island, Holbrook, Massachusetts.

Analytical equations and graphical solutions are available for estimating flow rates and limits of the hydrodynamic isolation under various boundary conditions. These equations and digital computer models are utilized to achieve maximum efficiency in isolating the contaminated groundwater at three EPA priority hazardous waste sites. A recirculation system comprising five pumping wells and an upgradient recharge trench, was successful in temporarily retarding the advance of a highly contaminated plume at the site in Nashua, New Hampshire. Results of three-dimensional computer analyses for the same site indicate that a more advanced hydrodynamic isolation system consisting of pumping wells and trenches in conjunction with a slurry cutoff wall could reduce 55,000 gallons (208 cu m) of contaminated groundwater presently being discharged to streams every day to less than 6,000 gallons (23 cu m). The hydrodynamic isolation system comprising a pumping well and five infiltration galleries combined with an oil/water separation mechanisms both slowed the advance of contaminated groundwater and by removing floating oils, reduced the concentrations of chemical constituents at a site in Burrillville, Rhode Island, before the designed treatment plant went into operation. A similar system, consisting of two collection wells and four recharge chambers, designed as an emergency action for a site in Holbrook, Massachusetts, is expected to reduce the 22,000 gallons (83 cu m) of contaminated groundwater passing through the chemical disposal area every day by up to 79%. (See also W87-01669) (Lantz-PTT)
W87-01675

DETERMINING OPTIMUM PUMPING RATES FOR CREATION OF HYDRAULIC BARRIERS TO GROUND WATER POLLUTANT MIGRATION,
Battelle Pacific Northwest Labs., Richland, WA.
J. M. Schafer.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 50-60, 10 fig, 5 tab, 17 ref. NRC Contract DE-AC06-76RL 1830.

Descriptors: *Pumping tests, *Water pollution control, *Hydraulic barriers, *Groundwater pollution, *Path of pollutants, Groundwater movement, Mathematical studies, Algorithms, Computers, Flow pattern, Flow rate.

In certain groundwater flow regimes control of the migration of pollutants can be achieved by hydraulic barriers created by groundwater withdrawal and/or injection. However, for complicated flow domains and situations where multiple wells may be installed, the determination of pumping rates to achieve a pollution control objective can be difficult. A non-linear programming (NLP) algorithm is coupled to a two-dimensional, steady-state, groundwater flow model and an advective transport model, for determination of optimum pumping rates for creation of hydraulic barriers. This technique is a screening tool for the selection of pumping rates, to be subsequently confirmed with more detailed simulation. Utilization of this technique can save time and cost over traditional trial and error methods of determining pumping rates. Two example applications of this technique are presented. The first example shows how NLP can be used to determine pumping rates required to develop a stagnation point. Optimum pumping rates for eight wells arranged in a circular configuration are determined so as to reduce the groundwater velocity to near zero over a precise region within a heterogeneous aquifer. The second example involves the determination of optimum steady-state pumping rates for six wells in a heterogeneous flow domain where the objective is the control (i.e. 'steering') of the trajectory of a contaminant plume. (See also W87-01669) (Lantz-PTT)
W87-01676

DOUBLE-CELL HYDRAULIC CONTAINMENT OF POLLUTANT PLUMES,
J. L. Wilson.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 65-70, 8 fig, 2 ref.

Descriptors: *Double-cell hydraulic containment, *Groundwater pollution, *Plumes, *Water pollution control, Pump wells, Aquifers, Water pollution treatment, Hydraulic structures.

Analytical solutions and type curves describe the design and evaluation of double-cell hydraulic containment. The inner recirculation cell is created by a recharge pit and pumping well, designed to flush the pollutant plume out of the aquifer for treatment at the surface. The outer recirculation cell, created by a recharge and discharge well pair, circulates a much larger volume of water. Hydraulic containment and flushing of a pollutant plume provides the opportunity to put water supplies, such as Cape Cod's South Hollow Well Field, back into service while remediation continues. Double-cell hydraulic containment also: (1) Minimizes the volume of water requiring treatment and maximizes the pollutant concentration; (2) Reduces flushing times; (3) Provides flexibility, permitting a control on flushing time without changing the rate of water produced from the inner cell for treatment; and (4) Contains the pollutant plume. If the inner cell system fails, the outer cell contains and collects any escaping pollutant. (See also W87-01669) (Lantz-PTT)
W87-01677

PRACTICAL ASPECTS OF THE DESIGN, INSTALLATION AND OPERATION OF GROUND WATER EXTRACTION SYSTEMS,
Harding-Lawson Associates, Novato, CA.
For primary bibliographic entry see Field 2F.
W87-01678

ASSESSMENT OF PURGE WELL EFFECTIVENESS FOR AQUIFER DECONTAMINATION,
Geologic Testing Consultants Ltd., Ottawa (Ontario).
R. B. Whiffen, and J. M. Bahr.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 75-81, 14 fig, 3 tab, 4 ref.

Descriptors: *Purge wells, *Aquifers, *Groundwater pollution, *Water pollution treatment, Water quality control, Ottawa, Canada, Sand, Gravel, Volatile organics, Plumes, Monitoring, Tracers, Kinetics.

A purge well test study was undertaken during the 1983 field season in a contaminated sand and gravel aquifer near Ottawa, Canada. The contaminants present consist primarily of volatile organics from the disposal of laboratory wastes. The objectives of the study include characterization of the desorption parameters of the organics and evaluation of the effectiveness and applicability of the

purge well technique for aquifer decontamination. Within the contaminant plume, the contaminants present in highest concentrations were diethylether and tetrahydrofuran with lesser concentrations of benzene, toluene, dichloromethane, 1,2-dichloroethane, 1,1-dichloroethylene, trans-1,2-dichloroethylene and 1,1,1-trichloroethane. Test methodology consisted of injecting fresh water in one while simultaneously withdrawing contaminated water from a second well at 5 m distance and monitoring the contaminant desorption in the aquifer at numerous multi-level sampling points strategically situated within the two-well flow field. Two nonreactive tracers, iodide and metatrifluoromethylbenzoic acid, were added at the injection well to monitor fresh water transport. Groundwater concentrations for the nine volatile organics and the two tracers were monitored over a six-day test period that included three step changes in injection-withdrawal flow rate. Groundwater samples for volatile organic analysis were collected using methods which minimized both atmospheric contamination and the loss of the volatiles. Dispersivities of approximately 5 cm were obtained from the analysis of the nonreactive tracer breakthrough curves from the multi-level point-sampling devices. Considerable tailing of the desorption curves was observed and is attributed to nonequilibrium (kinetic) efforts on the desorption process. (See also W87-01669) (Lantz-PTT)
W87-01679

SUBSURFACE ORGANIC RECOVERY AND CONTAMINANT MIGRATION SIMULATION,
P. L. Campbell, R. C. Bost, and R. W. Jacobsen.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 82-88, 4 fig.

Descriptors: *Simulation analysis, *Water pollution control, *Path of pollutants, *Organic compounds, *Water quality control, *Groundwater pollution, Aquifers, Pump wells, Groundwater movement, Geohydrology.

A groundwater contamination investigation and remedial action program was implemented at a major chemical plant. Investigations were completed (1) to identify spatial contaminant extent, and (2) to identify and eliminate a myriad of horizontal and vertical migration pathways. Actions were taken to remedy the circumstance. Several approaches and techniques were used to delineate the movement of free-phase shallow subsurface organic contamination, discover the mechanism of migration to an underlying industrial aquifer and develop early corrective responses. Approaches and techniques that should find wide applicability include: (1) Development of an understanding of regional aquifers; (2) Analysis of previous plant geotechnical data; (3) Field-mapping of soil contaminant levels with an organic vapor analyzer; (4) Organization and interpretation of pumping and chemical character data for supply and recovery wells; (5) Formulation and evaluation of hypotheses regarding potential sources and migration pathways; (6) Execution of flow and transport modeling, coupled with field calibration; and (7) Implementation of a management plant to complete corrective strategies. (See also W87-01669) (Author's abstract)
W87-01680

REMOVAL OF VINYLIDENE CHLORIDE FROM GROUND WATER BY AIR STRIPPING AND ACTIVATED CARBON ADSORPTION,
K. F. Whittaker, and J. C. Johnson.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 93-99, 5 fig, 3 tab, 5 ref.

Descriptors: *Vinylidene chloride, *Groundwater pollution, *Air stripping, *Activated carbon, Adsorption, *Water pollution treatment, Model studies, Water quality control, 1,1-dichloroethylene.

After review of the groundwater data and application of a sophisticated groundwater flow model, at an industrial facility in eastern Massachusetts contaminated with a number of volatile organics, it was decided that activated carbon adsorption and air stripping showed the greatest promise for contaminant removal. To evaluate these treatment methods in detail, an extensive pilot-scale study was implemented to accomplish four objectives: (1) To identify the highest water quality achievable by activated carbon contact; (2) To quantify effective carbon adsorption life; (3) To generate air stripping operating data sufficient for development of full-scale design criteria; and (4) To identify potential operating problems with both systems. Studies were carried out on two different well water supplies in which 1,1-dichloroethylene was the primary contaminant. Consistent removal 1,1-dichloroethylene to levels of less than 1 ppb has been shown to be possible using either granular-activated carbon adsorption or air stripping. Results from activated carbon adsorption tests also indicate that within narrow limits, published isotherm data can be used as an indicator of carbon column capacities until breakthrough. Performance data demonstrate quite strongly that decreasing water flux definitely decreased the height of the transfer unit, and consequently more efficient stripping was achieved at lower hydraulic application rates. (See also W87-01669) (Lantz-PTT)
W87-01681

AIR STRIPPING FOR VOCS IN WATER: PILOT-DESIGN-CONSTRUCTION,
F. C. Lenzo.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 100-110, 7 fig, 3 tab, 8 ref.

Descriptors: *Air stripping, *Volatile organics, *Pilot plants, *Design standards, *Construction, Water quality control, Gas chromatography, Mass transfer, Organic compounds, Water pollution treatment.

In an air-stripping system air and water are run countercurrent over a layer of loose-dumped or structure packing. Intimate mixing takes place and the contaminant moves out of the water and into the relatively clean passing air. The water is collected at the base of the unit and the air is dispersed into the atmosphere. Design procedures for air-stripping systems are still being developed and improved. Although modeling has been done with these systems, much remains to be learned. As a result of this situation, test work becomes a necessary part of design. During pilot-scale studies a variety of air-to-water ratios and water loadings are tested using a scaled-down air stripping unit. For each test run, samples are taken at various depths of packing and analyzed for organic contaminants using gas chromatography. The test results are used in combination with mass transfer theory and previous test and full-scale experience to arrive at design constants. Air stripping has proven itself a cost-effective, practical method of treatment for water contaminated with organic compounds. The exact limits of its applicability are still being explored and its use in potable water treatment and waste site cleanup have made it visible as a potential process/treatment system for resource recovery and industrial applications not attempted before. (See also W87-01669) (Lantz-PTT)
W87-01682

BIOLOGICAL TREATMENT OF ETHYLENE GLYCOL-CONTAMINATED GROUND WATER AT NAVAL AIR ENGINEERING CENTER LAKEHURST, NEW JERSEY,
O.H. Materials Co., Findlay, OH.
P. E. Flathman, J. R. Quince, and L. S. Bottomley.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 111-119, 4 fig, 2 tab, 33 ref.

Descriptors: *Biological treatment, *Ethylene glycol, *Groundwater pollution, *Lakehurst, New Jersey, Water pollution treatment, Cost-benefit analysis, Case histories, Effluents, Biodegradation, Water treatment, Organic compounds, Nitrogen, Phosphorus.

Biological treatment following spills of biodegradable hazardous organic compounds in the soil/groundwater environment can be a cost-effective technique when proper engineering controls are applied. Biodegradation of hazardous organic contaminants by microorganisms can minimize liability by converting toxic reactants into harmless end products. The case history presented describes: (1) bench scale evaluation of the potential for biological cleanup in the spill site matrix, (2) field implementation and (3) removal rates of ethylene glycol at the spill site. The underground recovery and treatment system, was used to effectively address ethylene glycol contamination in the groundwater environment. For this project, a recovery system was used to withdraw contaminated water from the ground for aboveground biological treatment. Effluent from the treatment system was reinjected into the subsurface environment, creating a closed-loop system. Biodegradation of ethylene glycol took place in the soil/groundwater environment, as well as aboveground in the biological treatment system. The injection system was used to inoculate the underground environment with microbes capable of biodegrading the organic contaminants and to provide the inorganic nitrogen and phosphorus necessary to support microbial growth. Cost-effectiveness, minimal disturbance to existing operations, on-site destruction of spilled compounds and permanence of solution are several of the advantages identified in this project for implementing biodegradation as a technique for spill cleanup and environmental restoration. (See also W87-01669) (Author's abstract)
W87-01683

BIOLOGICAL TREATMENT OF A BRINE GROUND WATER CONTAMINATED WITH HIGH CONCENTRATIONS OF ORGANICS,
DETOX, Inc., Dayton, OH.
E. K. Nyer, and R. E. Sauer.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 120-126, 12 fig, 4 ref.

Descriptors: *Biological treatment, *Groundwater pollution, *Brines, *Organic compounds, Saturation zone, Waste management, Water quality control, Pumps, Activated sludge, Organic carbon, Water treatment.

A shallow, saline, non-potable saturated zone consisting of silty-sand was contaminated under a hazardous waste management facility when a pond liner was punctured by construction equipment during a cleaning operation. Water is withdrawn from several central wells, treated, and recharged to the aquifer. The combined central wells have an average concentration of 15,000 mg/L dissolved solids and 1,300 mg/L total organic carbon (TOC) with the main component being 400 mg/L of phenol. The recharge water must have less than 18 mg/L TOC and less than 0.2 mg/L phenol. The aquifer is a natural brine aquifer so the dissolved solids will not be removed. Based upon the development of the groundwater recovery system and full-scale treatment system, several conclusions can be made: (1) For wells placed in shallow silty-sand layer, eductors will be more efficient than submersible pumps; (2) Although there are maintenance problems associated with the eductors, they are not as labor-intensive as the submersible pumps; (3) French drains and re-injection pits can be used to quickly alter a groundwater flow pattern; (4) The full-scale treatment system design included a first-stage activated sludge system, a second-stage fixed film/activated sludge system, a dual media filter and a carbon adsorption column. This system was economical and could easily be changed to reflect the changes in the influent concentration; (5) After overcoming salt inhibition and low-nutrient concentration, the pilot plant was able to consistently remove 70% of the influent TOC; and (6) Site personnel with no previous water treatment experience can be trained to operate a biological system. (See also W87-01669) (Lantz-PTT)
W87-01684

EVALUATION OF A PROPOSED SYNTHETIC CAP AND CONCRETE CUTOFF WALL AT LOVE CANAL USING A CROSS-SECTIONAL MODEL,
GeoTrans, Inc., Reston, VA.
R. M. Cohen, and J. W. Mercer.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 131-143, 26 fig, 4 tab, 14 ref. EPA Contract No. 68-01-6713.

Descriptors: *Groundwater pollution, *Synthetic caps, *Concrete, *Cutoff wall, *Love canal, *Models, *Water pollution treatment, Cutoffs, Niagara Falls, New York, Hydraulic design, Hydraulic gradient, Flow profiles, Dolomite, Seasonal variation, Permeability, French drains.

Remedial actions taken at the Love Canal site in Niagara Falls, New York, consist of a clay cover and french drain, which were constructed in 1978 and 1979. Additional remedial measures proposed included encapsulating the site with a concrete cutoff wall and a semi-impermeable cover. The potential hydraulic effects of these proposed additional remedial actions are evaluated using a numerical model. Several different cases are considered and include: no additional corrective actions, synthetic cover only, synthetic cover and cutoff wall, and addition of a second french drain. The effectiveness of these cases was evaluated with regard to: dewatering the shallow flow system, french drain flux, and reversal of vertical hydraulic gradients. The study concluded that: (1) For the case of no additional corrective actions, the simulated drain flux 50 years after the date when the proposed measures would have been installed is 0.128 cu ft/day per foot of drain; (2) An extended impermeable cap without a wall would reduce drain flux by approximately 50-70%, compared to the case of no additional corrective action; (3) The incremental effect of a wall may reduce drain flux by approximately 10%; (4) The maximum reduction in drain flux due to the wall will be realized about 20 years after construction; (5) A cutoff wall may substantially reduce ground water inflow in areas of increased permeability; (6) The flow system at present, assuming no additional corrective action and ignoring seasonal variation, may be near steady state; (7) The wall would have no effect within the area bounded by the french drain system; (8) A reversal of gradient between the Lockport dolomite and shallow flow system may occur within the area bounded by the french drain without any additional corrective action; (9) The reversal of gradient in the area between the drain and wall would be more extensive if the wall is constructed; (10) Wall construction would restrict contaminant movement in either direction through the shallow flow system at the wall location; and (11) Installation of a second french drain instead of a cutoff wall at the location of the proposed wall would better achieve all goals of the remedial program except for the objective of reducing long-term operating costs associated with handling and treating drain flux. (See also W87-01669) (Lantz-PTT)
W87-01685

TRANSPORT MODELING IN THE RESTORATION OF STRATIFIED AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
J. G. Melville, O. Guven, and F. J. Molz.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 144-150, 13 fig, 6 ref. EPA Agreement CR810701-01-0.

Descriptors: *Model studies, *Water pollution treatment, *Dispersion, *Groundwater movement, *Path of pollutants, *Groundwater pollution, *Water pollution treatment, Aquifers, Stratification, Mathematical studies, Pumping, Hydraulic conductivity.

A method of aquifer restoration that may be economically feasible is the removal of contaminated water by pumping from withdrawal wells. Previous studies about the applicability of solute transport models to the initial evaluation of such pumping schemes, concluded that advection-based models may be the most practical evaluation alternative. The present paper builds on this by dealing in more detail with advection-based models of contaminant recovery from aquifers having discrete or continuous horizontal layering (stratification) parallel to the flow direction. The mathematics describing advection-dominated contaminant transport when dispersion is neglected are often relatively simple. In the case of a stratified aquifer, non-dimensional expressions are developed for recovery times and compared with recovery times for an 'equivalent' homogeneous aquifer. Expressions for the recovery concentration history are also developed. The analysis shows the importance of at least considering the vertical variation of horizontal hydraulic conductivity when attempting to model contaminant migration in groundwater. An important point to be made in this study is that modest variations in hydraulic conductivity K(z) that are undetectable in standard pumping tests can induce considerable mixing. If this advective-dispersion is interpreted as the dispersion in the one-dimensional advection-dispersion model, a simple explanation of scale dependent dispersivity can be developed. From a practical point of view, the results strongly suggest that careful measurement of K(z) is important for development of aquifer restoration schemes. (See also W87-01669) (Lantz-PTT)
W87-01686

MODEL STUDY OF SELECTED MITIGATIVE STRATEGIES TO CONTROL RADIONUCLIDE MIGRATION IN GROUND WATER,
Battelle Pacific Northwest Labs., Richland, WA.
R. L. Skaggs.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 151-161, 21 fig, 2 tab, 13 ref.

Descriptors: *Model studies, *Water quality control, *Radioisotopes, *Path of pollutants, *Groundwater movement, *Groundwater pollution, Texas, Flow profiles, Groundwater barriers, Piezometry, Injection wells, TRANS, Hydraulic gradient, Cutoffs.

A groundwater flow and transport model is used to evaluate the effectiveness of selected contaminant mitigation techniques to control radionuclide migration in groundwater. The study is conducted for a shallow, semiconfined aquifer located in the Gulf Coastal Plain of Texas. A point source release of strontium-90 is assumed. The redirection of groundwater flow and, consequently, transport to more circuitous routes is the basic strategy evaluated. This strategy results in longer travel times and, therefore greater natural decay of radionuclides. The mitigative techniques considered include: (1) construction of engineered barriers to groundwater flow and transport, and (2) groundwater withdrawal and injection for piezometric surface modification. The study is conducted using TRANS, a two-dimensional groundwater flow and transport code developed by the Illinois State Water Survey. With its many features (i.e. the ability to simulate the effects of internal and external boundaries, pumping and injection, etc.), TRANS provides the means to evaluate performance of both engineered barriers and groundwater withdrawal/injection with reasonable ease and efficiency. The evaluation of the mitigative techniques is made on the basis of achievable mitigation (i.e. increase in path length and travel time) as a function of site hydrogeology and basic mitigative technique design characteristics. The model simulation results indicate that all the mitigation measures evaluated would significantly increase groundwater and contaminant travel times. The results also indicate that the hydraulic barrier evaluated would be more effective in mitigating radionuclide migration at the study site than the specific constructed barriers considered. Finally, upgradient cutoffs proved more effective in increasing groundwater travel time than downgradient cutoffs of the same length. (See also W87-01669) (Lantz-PTT)
W87-01687

REMEDIAL ACTION EVALUATION WITH SIMPLIFIED METHODS,
Anderson-Nichols and Co., Inc., Palo Alto, CA.
S. M. Brown.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 162-172, 7 fig, 3 tab, 39 ref. EPA Contract No. 68-03-3116.

Descriptors: *Water pollution treatment *Groundwater pollution, *Waste management, *Wastewater treatment, Well hydraulics, Drain hydraulics, Groundwater mounding, Seepage, Infiltration, Mapping, Path of pollutants.

A number of analytical and semi-analytical methods are available for evaluating the performance of subsurface and waste control remedial actions. The available methods can be grouped as follows: (1) well hydraulics, (2) drain hydraulics, (3) groundwater mounding, (4) seepage/ infiltration, (5) superposition, (6) transformation methods, (7) conformal mapping, and (8) contaminant transport. These 'simplified methods' are ideally suited to the screening of potentially feasible remedial actions. In some cases, they can also be used to conduct detailed analyses and to develop conceptual designs. The basic assumptions and limitations underlying these methods precludes the complete, detailed evaluation of all remedial actions. Certain design objectives and remedial action configurations are difficult or impossible to analyze. Many of the more commonly used methods have been inventoried in several useful handbooks and manuals. A number of them have also been programmed for use on hand-held calculators and micro-computers. These programs expand the usefulness of certain methods and reduce the level of effort required to apply them to practical problems of interest to site contractors and state and federal superfund staff. (See also W87-01669) (Author's abstract)
W87-01688

USE OF COMPUTER MODELING TECHNIQUES IN THE DESIGN OF A MONITORING PROGRAM AT A HAZARDOUS WASTE SITE,
Jordan (Edward C.) Co., Inc., Portland, ME.
J. E. Sevee, and R. A. Lewis.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 195-199, 2 fig.

Descriptors: *Path of pollutants, *Groundwater movement, *Computer models, *Monitoring, *Hazardous wastes, *Waste disposal sites, *Design standards, Love Canal, New York, Water quality control, Model studies, Path of pollutants, Cost-benefit analysis, Water pollution treatment.

General considerations for the design of a long-term monitoring program are discussed as specifically applied to the Love Canal site. In this ongoing project, numerical methods are used to simulate the hydrogeology of the site, utilizing parametric analysis in areas where data is limited. The latest data available from a recently completed review of all available data from Love Canal studies and information will be utilized in the calibration of the model. Modeling is viewed as a useful tool in the design of a long-term monitoring program whose goals are to: (1) Maintain surveillance of chemical migration; (2) Provide early warning of significant migration; (3) Provide data on the effectiveness of current and proposed remedial actions; and (4) Provide a data base for habitability decisions. The modeling effort will be used to define probable pathways, and rates of conservative solute transport, for the selection of existing wells or the placement of new wells, to provide a cost-effective monitoring program to meet the defined goals. (See also W87-01669) (Lantz-PTT)
W87-01691

BACKGROUND GROUND WATER QUALITY MONITORING: TEMPORAL VARIATION,
Jordan (Edward C.) Co., Inc., Portland, ME.
D. C. Allen, and S. E. Walker.
IN: The Fourth National Symposium and Exposi-

tion on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 226-231, 7 fig, 1 tab, 10 ref.

Descriptors: *Baseline studies, *Groundwater quality, *Monitoring, *Temporal variations, Landfills, *Groundwater pollution, *Observation wells, Water quality control, Water pollution effects, Seasonal variations, Aquifers, Graphical analysis.

Current landfill disposal practices and regulations require the installation and periodic sampling of groundwater monitoring wells to measure background, and to monitor operational and post-closure, groundwater quality at landfill sites. For the results of this monitoring to be meaningful, the reviewer must have a sound understanding of the potential variations in groundwater quality prior to the onset of any landfill contaminant impact. Apart from differences in sampling and analytical procedures, significant variations may result from the trauma of the monitoring well installation or from temporal variations in the natural quality of the groundwater. This paper presents and reviews background water quality data from nine monitoring wells at four geologically different sites in northern New England. Graphical techniques are used to identify monitoring parameters that exhibit temporal variation. The results of this study indicate: temporal variation is apparent in monitoring wells sampled quarterly for as few as two years; certain monitoring parameters exhibit recurring temporal variation closely correlated with seasonal changes; recurring seasonal variation in groundwater quality shifts slightly from year to year; the amplitude and frequency of temporal variation is dependent to a degree on the depth and nature of the aquifer. (See also W87-01669) (Author's abstract)
W87-01695

GROUND WATER MONITORING: A PRACTICAL APPROACH FOR MAJOR UTILITIES,
For primary bibliographic entry see Field 5B.
W87-01699

DRILLING CONTAINMENT SYSTEM FOR HAZARDOUS WASTE SITE INVESTIGATIONS,
O.H. Materials Co., Findlay, OH.
J. R. Hitchings, and L. Holm.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 283-287, 7 fig.

Descriptors: *Drilling wastes, *Hazardous wastes, *Waste disposal, *On-site investigations, Hydrogeology, Observation wells, Water pollution prevention, Ohio, Design standards, Construction, Monitoring, Cost-benefit analysis.

Hydrogeological investigations at hazardous waste sites normally require the installation of wells beyond the waste site boundaries to adequately determine the extent of contamination and the appropriate remedial action alternatives. During the installation of these off-site site wells, a good deal of waste is generated at each location. These wastes may be contaminated and must be contained in order to protect the public, the localized environment and the drilling contractor. This paper describes the design, construction and implementation of the drilling containment system utilized for off-site wells at Chem-Dyne, in Ohio. The effectiveness of the containment system is reviewed in terms of the objectives achieved and the quantity of waste material recovered from the containment system. The drilling containment system utilized for the installation of off-site monitoring wells at the Chem-Dyne facility proved effective in attaining the objectives desired. Most importantly, the containment system provided a means to effectively contain the migration of potentially hazardous substances into a sensitive environment. Although a containment system adds to the cost of installation of monitoring wells, it is believed that the inherent benefit of containing the waste products and in belaying potential litigation and bad public relations is well worth the investment by a drilling contactor. (See also W87-01669) (Lantz-PTT)
W87-01701

IDENTIFICATION AND REMOVAL OF HYDROCARBONS FROM UNCONSOLIDATED SEDIMENTS AFFECTED BY TIDAL FLUCTUATIONS,
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 5A.
W87-01706

PETROLEUM PRODUCT RECOVERY IN COASTAL FACILITIES UTILIZING TIDAL FLUCTUATIONS,
Haley and Aldrich, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5B.
W87-01707

GROUND WATER DECONTAMINATION TECHNIQUES FOR REMOVAL OF FREE FLOATING AND DISSOLVED HYDROCARBONS FROM A WATER TABLE AQUIFER OVERLYING THE FLORIDAN AQUIFER IN SOUTHWEST FLORIDA,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
For primary bibliographic entry see Field 5D.
W87-01708

PUMPED REMOVAL OF IMMISCIBLE PHASES: AN OVERLOOKED ALTERNATIVE AT HAZARDOUS WASTE SITES,
D. F. Unites, J. Wolf, and M. I. Casslar.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 339-344, 2 fig, 2 tab, 2 ref.

Descriptors: *Pumps, *Immiscible phases, *Hazardous wastes, *Disposal sites, Water pollution treatment, Industrial wastes, Cost analysis, Groundwater pollution, Creosote, Tar, Polychlorinated biphenyls, Sands, Gravel.

The pumped removal of immiscible fluid phases has a long record of successful application for aquifer renovation in the petroleum industry. However, very little consideration has been given to the use of this technique in the remedial actions at hazardous waste sites. At these sites, typically some form of containment or excavated removal is proposed. Less often, the pumping and treatment of contaminated groundwater may be considered. Where suitable conditions exist, pumped removal, either alone or in combination with other remedial activities, may offer a more cost-effective means of reducing the overall environmental risks. The feasibility of pumped removal is dependent on the nature of the contaminant and the hydrologic environment. Immiscible fluids such as creosote, tars, PCB-contaminated oils and certain solvents are candidates for removal. Highly pervious geologic environments such as coarse sands and gravels or highly fractured zones offer the best possibilities of recovery. (See also W87-01669) (Author's abstract)
W87-01709

ORGANIC CONTAMINANT CONTROL IN A GULF COAST AQUIFER,
B. S. Yare, J. A. Connor, and D. J. Schaezler.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 371-374, 2 fig, 4 tab.

Descriptors: *Organic compounds, *Groundwater pollution, *Water pollution control, *Water quality, Control, *Coastal aquifers, Industrial wastes, Waste storage, Organic solvents, Plumes, Path of pollutants, Sinks, Wastewater treatment, Aeration, Observation wells, Air stripping, Pumping.

A Gulf Coast electronic products company stored spent organic solvents in a buried concrete tank. Observation wells installed adjacent to the tank detected solvents in the saturated silty sand underlying the site. Additional observation wells were installed to define the areal extent of the contaminant plume and determine its direction and rate of movement. A pumping withdrawal system was designed with distance-drawdown data obtained from a pumping test on wells located in the center of the plume. Withdrawal of 30 gpm from each of three existing observation wells will produce a hydraulic sink over the entire areal extent of the contaminant plume. Treatability studies indicated that passing the withdrawn groundwater through an existing waste water aeration tank was the least expensive treatment alternative as compared to building a new packed column or using an existing cooling tower to air strip the withdrawn groundwater. The withdrawal and treatment systems were put into operation in March 1984. Routine monitoring is planned to determine the effectiveness of the withdrawal system. (See also W87-01669) (Author's abstract)
W87-01713

ON-SITE CONTAINMENT OF PCB-CONTAMINATED SOILS AT AEROVOX INC., NEW BEDFORD, MASSACHUSETTS,
For primary bibliographic entry see Field 5B.
W87-01714

GROUND WATER RESTORATION PROJECTS: FIVE CASE HISTORIES,
O.H. Materials Co., Findlay, OH.
D. L. Winegardner, and J. R. Quince.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 386-393, 11 fig.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Case studies, *Groundwater decontamination, Aquifer characteristics, Water quality control, Geohydrology, Water pollution sources, Path of pollutants, Water use, Chemical analysis, Physical analysis, Regulations.

The selection of the most appropriate recovery/treatment technique(s) needed to restore a contaminated aquifer is a multifaceted process. Several important parameters that require evaluation to determine the appropriate alternatives are listed below (not necessarily in order of importance): age of contaminant incident, size and type of source (slug or continuous), extent of contamination in lateral and vertical directions, hydrogeologic setting, use of local groundwater (immediate and long term), chemical and physical character of contaminant(s), public opinion, dictates (guidance) of regulatory agencies, natural in situ chemical/biological treatment, and source removal. After careful consideration of each of these parameters and some preliminary studies of the site involved, an optimum restoration program can be designed and implemented. The factors listed above may vary in significance and in some cases may not be important. Each of the case histories discussed in this paper have been designed to accomodate the specific parameters involved. The cases range from immediate action following a spill to planned recovery of material that had been present in the ground for possibly 100 years. (See also W87-01669) (Lantz-PTT)
W87-01715

IMPACT AND RECOVERY OF CHROMIUM WASTE LEAKED BENEATH AN INDUSTRIAL PLANT,
Ontario Ministry of the Environment, Toronto.
B. Novakovic.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 394-400, 6 fig, 3 ref.

Descriptors: *Chromium, *Industrial wastes, *Leakage, *Fate of pollutants, Water pollution effects, Ontario, Geohydrology, Drinking water, Water quality control, Surface water, Groundwater decontamination, Wells, Glacial tills, Pumping.

Due to the use of improper liner material, chromium plating solution leaked beneath the 0.2 m concrete floor of an industrial plant in southern Ontario in early December, 1982. This resulted in a loss

of 2,273 kg of chromic acid. Geological and man-made factors controlled the migration of the leaked chromium plating solution. The bulk of the solution remained beneath the floor of the plant in permeable granular fill material. The underlying non-permeable glacial till and an existing low permeability embankment outside the plant, prevented significant downward and lateral migration of the chromium solution. Although the extent of subsurface contamination was limited and there was no immediate threat to the groundwater, there was a potential for chromium waste to reach the nearby surface water system, thus endangering the public water supply source and aquatic life in general. Mitigative measures included prevention of contaminated water from leaving the property and subsequent water treatment. This was followed by the construction of a system of properly screened wells with intakes placed immediately above the glacial till at strategic locations, predominantly inside the plant. The wells were initially pumped and used as an injection-recovery well system, effectively removing the bulk of chromium from the shallow subsurface. Within six months, 78% recovery of the lost chromium was attained. in the process, 3,420 cu m of contaminated water was pumped, pretreated and then treated at the company's waste water treatment plant, where chromium was removed. Thus, the potential of contamination of the public water supply and surface water was eliminated. (See also W87-01669) (Lantz-PTT)
W87-01716

AVAILABILITY OF AUTOMATIC WATER QUALITY MONITORING FOR FINNISH WATERCOURSES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W87-01739

SOLUTE-LOADING SOURCES IN THE DIRTY DEVIL RIVER BASIN, UTAH,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5B.
W87-01758

OVERVIEW OF ENVIRONMENTAL SURVEILLANCE OF WASTE MANAGEMENT ACTIVITIES AT THE IDAHO NATIONAL ENGINEERING LABORATORY,
Idaho National Engineering Lab., Idaho Falls.
T. H. Smith, T. G. Hedahl, E. W. Chew, G. B. Wiersma, and L. J. Mann.
Informal Report EGG-WM-7155, February 1986. 10 p, 6 fig, 2 tab, 7 ref. DOE Contract No. DE-AC07-761D01570.

Descriptors: *Environmental effects, *Radioactive wastes, *Waste management, *Idaho, *Monitoring, Snake River, Aquifers, Regulations, Waste disposal.

Extensive environmental surveillance is conducted at the Idaho National Engineering Laboratory (INEL) of the Department of Energy (DOE). Surveillance of waste management facilities is integrated with the overall INEL Site surveillance program. The following four components of the surveillance program will be briefly discussed in this paper. (1) Continuing surveillance of environmental impacts on the Site, at the Site boundary, and at nearby communities is performed by DOE's Radiological and Environmental Sciences Laboratory (RESL). (2) The Snake River Plain aquifer, which underlies the INEL, is monitored by the U.S. Geological Survey (USGS). (3) Surveillance at INEL facilities, including waste management facilities, is conducted by their respective operating contractors. (4) Special surveillance studies are conducted. The discussion focuses on monitoring the environmental impacts of waste management activities, rather than on monitoring facility releases for purposes of showing regulatory compliance. Results to date indicate very small or no impacts from the INEL on the surrounding environment. Environmental surveillance activities are currently underway to address key environmental issues at the INEL. (Lantz-PTT)
W87-01762

CENTRALIZED WASTE TREATMENT OF INDUSTRIAL WASTEWATER,
JRB Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5D.
W87-01770

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

RESEARCH DESIGN FOR THE INVESTIGATION OF THE MARANA COMMUNITY COMPLEX,
Arizona State Univ., Tempe. Dept. of Anthropology.
G. E. Rice, T. K. Henderson, and S. k. Fish.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86-159969, A07 in paper copy, A01 in microfiche. Anthropological Field Studies Report No. 10, December 1985. 122 p, 30 fig, 11 tab, 71 ref.

Descriptors: *Archaeology, *Research design, *Marana, *Arizona, Tucson, Phoenix, Basins, Aqueducts, Colorado River.

The Marana Archaeological Project was conducted as part of the construction of Phase A of the Tucson Aqueduct, a feature of the central Arizona Project being built under the authority of the Bureau of Reclamation, Department of the Interior, to bring water from the Colorado River to the Phoenix and Tucson Basins of Central Arizona. This is a design for the archaeological investigation of a complex of sites in the vicinity of Marana, Arizona. The proposed study will focus on the organization of Classic Period Communities, and is designed to generate data which can be used for a quantitative evaluation of degrees of specialization in craft production, access to trade goods, subsistence activities, and status. It is posited that the Classic Period is characterized by greater degrees of specialization than the pre-Classic, and that this will be reflected in the organization of communities. The research design presents a set of field and analytical methods necessary for the recovery of the appropriate categories of data, and includes discussions of methods, and statistical procedures for the reconstruction of community patterns. (Author's abstract)
W87-00877

METHOD TO OPTIMIZE THE FLOOD RETENTION CAPACITY FOR A MULTI-PURPOSE RESERVOIR IN TERMS OF THE ACCEPTED RISK,
Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
For primary bibliographic entry see Field 4A.
W87-01194

ALLOCATION OF AUGMENTED WATER SUPPLY UNDER A PRIORITY WATER RIGHTS SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W87-01448

WATER QUALITY MONITORING IN THE STATE-MANAGED WATERS OF THE NETHERLANDS,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands). Surface Water Branch.
For primary bibliographic entry see Field 5G.
W87-01475

TALLYING WATER RESOURCES GOALS,
Case Western Reserve Univ., Cleveland, OH.
For primary bibliographic entry see Field 6B.
W87-01522

CONSUMER SURPLUS UNDER UNCERTAINTY: AN APPLICATION TO DAM-RESERVOIR PROJECTS,
California Inst. of Tech., Pasadena.
For primary bibliographic entry see Field 6B.
W87-01524

HEURISTIC SOLUTION PROCEDURE FOR EXPANSION SEQUENCING PROBLEMS,
California Univ., Los Angeles. Dept. of Civil Engineering.
S. K. Kim, and W. W.-G. Yeh.
Water Resources Research WRERAO, Vol. 22, No. 8, p 1197-1206, August 1986. 6 fig, 12 tab, 24 ref. NSF Grant CEE-8113500.

Descriptors: *Heuristic solutions, *Expansion sequencing, *Management planning, *Mathematical studies, *Water resources development, Cost analysis, Algorithms, Computer programs.

Basin-wide water resource development planning frequently involves the problem of expansion sequencing. Expansion sequencing is the determination of the optimal sequencing and timing of a set of capacity expansion projects that minimize the total discounted investment cost while meeting demands projected over a planning horizon. Since several projects are available at different points of time to meet the growing demand, there is a possible advantage in delaying a portion of the total investment outlays. A heuristic solution procedure, developed for capacity expansion problems encountered in water resources development, consists of two steps. In the first step project sequence is generated, and capacity refinement is done in the second step. A shortest path dynamic programming solution scheme is used as a 'return function' for the sequence generation step, and a univariate direct search algorithm is used for capacity refinement. The proposed solution procedure is tested for both capacitated and uncapacitated example problems with a finite planning horizon. The results indicate that the proposed heuristic solution procedure is superior to other solution procedures selected for comparison in finding an optimum expansion policy consisting of a sequence of project developments, investment timing, and sizing for each project. (Lantz-PTT)
W87-01621

6B. Evaluation Process

TALLYING WATER RESOURCES GOALS,
Case Western Reserve Univ., Cleveland, OH.
B. F. Hobbs, and E. Z. Stakhiv.
Civil Engineering (ASCE) Vol. 56, No. 4, p 53-55, April 1986.

Descriptors: *Water resources, *Planning needs, *Economics, Comprehensive planning, Quantitative evaluation.

Engineers often look to quantitative methods for evaluating project impacts as they are spurred by new federal laws and guidelines. In preliminary project planning, these methods can help modify and screen alternatives, and ease final decision making by clarifying tradeoffs between alternatives and value judgments. There are four key criteria that help engineers to decide which of the quantitative evaluation methods are best for their planning needs. An appropriate method is suited to the organization's philosophy, which uses available data effectively and yields the type of information that both planners and the public need. Decision techniques must be easy to use because of the limited time and resources available to most water planning agencies. A decision making method is valid only when it accurately measures what it purports to. Studies in which two or more methods are applied to the same problem show that method choice often matters. Evaluation techniques that perform well under some of these criteria usually have shortcomings in others. Those interested in analysis methods should dig into available literature and decide which methods serve them best. (Khumbatta-PTT)
W87-01522

CONSUMER SURPLUS UNDER UNCERTAINTY: AN APPLICATION TO DAM-RESERVOIR PROJECTS,
California Inst. of Tech., Pasadena.
J. Quirk.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1307-1312, September 1985. 4 ref.

Descriptors: *Economic aspects, *Dams, *Reservoirs, *Project planning, *Cost-benefit analysis, Benefits, Project benefits, Cost analysis.

The use of cost-benefit analysis to evaluate the net welfare payoffs from water projects is an established practice. An interesting aspect of these studies is that water projects involve an uncertain flow of costs and benefits, arising from the stochastic nature of streamflows. Hence, a basic problem for the cost-benefit analyst is that of incorporating this uncertainty into his measures of costs and benefits. The author examines the problem of computing an appropriate consumer surplus measure to evaluate water project benefits under uncertainty. Detailed treatment is given to the case in which a complete set of contingent claim markets exists in the economy as well as to the case of a spot market economy. The consumer surplus measure applicable to the contingent claim economy is a simple generalization of the measure that applies to a world of certainty, but in the case of a spot market economy there is an unobserved component of consumer benefits that limits the applicability of the usual consumer surplus measure. (Author's abstract)
W87-01524

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER RATES: AN INDUSTRIAL USER'S VIEW,
Drazen-Brubaker and Associates, Inc., St. Louis, MO.
E. Harwig, and R. A. Smith.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 42-46, May 1986.

Descriptors: *Water rates, *Industrial water, Water demand, Capital investment, Cost-based rates, Available water.

Observations on the availability and pricing of water for industrial use are presented here from the viewpoint of General Motors Corporation. General Motors negotiates contracts with water utilities based on fairness to both the corporation and the water utility. Water revenues, in the view of GM, should be reasonable and adequate to maintain the financial and operational stability of the water utility. Charges should be based on selfsupporting, cost-of-service rates with little customer cross-subsidization and minimal revenue subsidization from other sources, such as taxes. Written service contracts are suggested as an appropriate tool to achieve these goals. (Main-PTT)
W87-01019

COST BORNE BY ELECTRICITY CONSUMERS UNDER EXPANDED IRRIGATION FROM THE COLUMBIA RIVER,
Oregon State Univ., Corvallis.
B. A. McCarl, and M. Ross.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1319-1328, September 1985. 3 fig, 7 tab, 21 ref. Department of the Interior Grant 373906.

Descriptors: *Cost analysis, *Electric power, *Irrigation, *Columbia River, Water demand, Economic aspects, Water loss, Electric power production, Hydroelectric power.

The costs imposed on participants in the electricity market arising from irrigation diversions from the Columbia River are analyzed. The hypotheses considered are that (1) electricity consumers' welfare is not affected by irrigation diversion, (2) hydropower loss estimates derived using time and location-specific data do not differ from those derived using average data, (3) that water year does not affect welfare losses, (4) demand elasticity does not affect welfare losses, (5) farmer pumping payments do not affect welfare losses, and (6) interruption of water in critical flow years does not affect welfare losses. Electricity consumers are found to lose welfare when diversions are increased. Considering a potential diversion in central Washington, the annual loss to electricity consumers is in excess of $100 per acre developed. When the government delivers water to farmers' fields, this loss exceeds $200 per acre. Estimates are sensitive to the share that diverters pay of pumping costs and the potential interruption of diversions but not to different hydropower loss estimates, demand elasticity, and water year. The results under critical water year interruption show a potential for reducing the tradeoffs between irrigation development and hydroelectric power generation as the costs fall by almost 80%. (Author's abstract)
W87-01525

FINANCIAL AND ECONOMIC IRRIGATION NET BENEFIT FUNCTIONS FOR EGYPT'S NORTHERN DELTA,
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
R. L. Bowen, and R. A. Young.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1329-1335, September 1985. 1 fig, 2 tab, 25 ref. Agency for International Development project 931-0236.09.

Descriptors: *Benefits, *Monetary benefits, *Egypt, *Deltas, *Irrigation, *Cost-benefit analysis, Economic aspects, Water supply, Cost analysis, Marginal benefits, Water use, Prices, Case studies.

Financial and economic net benefits to irrigation water supply are estimated for a case study area in the northern Nile delta region of Egypt. Linear programming models of representative farms in the study area are formulated with particular attention to the possibilities of using less water per crop as well as shifting crops in response to hypothetical reductions in water supply. Net benefits are defined as gross revenues minus costs of production, including an imputed charge for family labor. Model solutions are based on both 1980 government prices with production controls (financial net benefits) and hypothetical 1980 international market prices with relaxed controls (economic net benefits). Five different water supply scenarios are analyzed: from the current, adequate level of supply, down to a 40% reduction from that level. Total, average, and marginal net benefit functions are reported, and implications of the differences between the financial and economic benefit functions for farmers are discussed. (Author's abstract)
W87-01526

6D. Water Demand

ALLOCATION OF AUGMENTED WATER SUPPLY UNDER A PRIORITY WATER RIGHTS SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
L. P. Graham, J. W. Labadie, I. P. G. Hutchison, and K. A. Ferguson.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1083-1094, July 1986. 9 fig, 4 tab, 18 ref. USDA Forest Service Research Contract No. 28-K3-297.

Descriptors: *Water supply, *Water rights, *Water allocation, Networks, Model studies, River basins, Computer models, Rio Grande River, Colorado, New Mexico, Texas, Pumping, Water use, Water demand, Water supply development.

A generalized network flow model has been developed to simulate the allocation of additional water supplies in a river basin with observance of the prior appropriation doctrine of water rights and other legal requirements such as interstate compact agreements. The computer model, called MODSIMR, is capable of simulating complex river basin morphology while incorporating a relational data based management system for efficiently accessing prioritized water rights. Program MODSIMR is a generalized model designed to be applicable to a wide variety of river basins operating under an appropriative water rights system. As a demonstration of its usage, MODSIMR was applied to the Rio Grande Basin of Colorado, New Mexico, and Texas for predicting allocation and use of increased runoff from simulated silvicultural activities on the Rio Grande National Forest. Results indicate that under the current institutional framework, increased runoff would primarily be allocated to agricultural users in Colorado. Computer results also showed the potential value to Colorado of the Closed Basin Project in the San Luis Valley and the possibility of determining optimal pumping schemes for the Project using MODSIMR. Program MODSIMR will be useful in future economic studies to determine the benefits of the augmented water supply under various water use scenarios. (Author's abstract)
W87-01448

HEURISTIC SOLUTION PROCEDURE FOR EXPANSION SEQUENCING PROBLEMS,
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-01621

MILITARY REQUIREMENTS FOR GEOPHYSICAL GROUND WATER DETECTION AND EXPLORATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 7B.
W87-01656

6E. Water Law and Institutions

ALLENTOWN INDUSTRIAL WASTE PRETREATMENT PROGRAM,
Environmental Management Associates, Inc., Trexlertown, PA.
For primary bibliographic entry see Field 5D.
W87-00840

WATER PROJECT CONSTRUCTION BACKLOG--A SERIOUS PROBLEM WITH NO EASY SOLUTION.
General Accounting Office, Washington, DC. Resources and Economic Development Div.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB83-178574, Price codes: A05 in paper copy, A01 in microfiche. Report by the Comptroller General of the United States, GAO/RCED-83-49, January 26, 1983. 69 p, 4 append.

Descriptors: *Planning, *Political constraints, *Economic aspects, *Construction, Water resources development, Corps of Engineers, Inflation, Financial feasibility, Cost analysis.

The U.S. Army Corps of Engineers and the Bureau of Reclamation started fiscal year 1982 with 934 authorized water projects, only 289 of which were funded by Congress. An estimated $35.5 billion (including estimates for future inflation) is needed to complete these projects. With annual construction funding of $1.4 billion (the average over the last 10 years) the Corps could complete its projects (costing $22.7 billion) in about 16 years. The Bureau's present backlog ($12.8 billion) could be completed in about 30 years at its present rate of funding, $440 million per year, and a 4% inflation rate. Since some projects can be eliminated because of loss of local support or high interest rates, the more realistic Corps construction backlog is estimated to be $15.4 billion. Operation and maintenance funding is taking an increasing share of the Corps' money spent on water resource activities, growing from 23% in 1973 to 37% in 1982. Corresponding figures for the Bureau are 9% in 1973 and 26% in 1982. Alternatives for reducing the backlog include providing additional funding, establishing a priority list, and having non-Federal entities share more costs. (Cassar-PTT)
W87-00950

FLOODPLAIN MANAGEMENT POLICY AS APPLICABLE TO HUD'S IMPLEMENTATION OF EXECUTIVE ORDERS 11988 AND 11990.
Department of Housing and Urban Development, Washington, DC. Office of Environment and Energy.
For primary bibliographic entry see Field 6F.
W87-00956

HIGH-STAKES WATER QUALITY SUIT IN TEXAS,
For primary bibliographic entry see Field 5G.
W87-01098

POLLUTER PAYS PRINCIPLE - WHO IS REALLY PAYING,
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
For primary bibliographic entry see Field 5G.
W87-01204

ALLOCATION OF AUGMENTED WATER SUPPLY UNDER A PRIORITY WATER RIGHTS SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W87-01448

PROTECTING THE CHESAPEAKE BAY: MARYLAND'S CRITICAL AREA PROGRAM,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
For primary bibliographic entry see Field 5G.
W87-01503

EC PROPOSAL FOR A COUNCIL DIRECTIVE ON WATER QUALITY OBJECTIVES FOR CHROMIUM,
Anglian Water Authority, Huntingdon (England).
For primary bibliographic entry see Field 5G.
W87-01516

6F. Nonstructural Alternatives

FLOODPLAIN MANAGEMENT POLICY AS APPLICABLE TO HUD'S IMPLEMENTATION OF EXECUTIVE ORDERS 11988 AND 11990.
Department of Housing and Urban Development, Washington, DC. Office of Environment and Energy.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-184721, Price codes: A03 in paper copy, A01 in microfiche. Background Paper Prepared for the Committee on Government Regulations and the Cost of Housing President's Commission on Housing. HUD-0002448, January 8, 1982. 28 p, 3 ref, 5 append.

Descriptors: *Planning, *Nonstructural alternatives, *Flood plain management, *Housing, Zoning, Flood plain zoning, Flood insurance, Insurance, Economic aspects.

Presidential Executive Orders 11988 and 11990 (May 1977) set forth the national policy which addresses the problem of unrestrained development in flood hazard areas and wetlands. Federal disaster assistance currently exceeds $1 billion each year. Other federal funds are used to subsidize the flood insurance program and relocate persons to flood-free areas. The Housing and Urban Development (HUD) policy (since August 1979) is not to reject proposals only wherever there is a practicable alternative, namely that flood-free properties are available elsewhere in the community. Federal policies concerning flood plain development have been contradictory and self-defeating. However, a strict application of the aforementioned presidential orders could adversely affect HUD's mission, in particular, areas where alternatives to building in flood plains are severely limited. HUD has requested (September 17, 1981) the following revisions of the orders, giving authority for the following: economical processing through an areawide compliance procedure, granting justifiable exemptions, simplifying procedures, and permitting reasonable, less restrictive, and more flexible national flood plain management standards and definitions that presently mandated by the National Flood Insurance Program. (Cassar-PTT)
W87-00956

6G. Ecologic Impact Of Water Development

BIOLOGICAL RESOURCES INVENTORY CONTRACT EXTENSION, TUCSON DIVISION - PHASE B--CENTRAL ARIZONA PROJECT AQUEDUCT,
Arizona Game and Fish Dept , Phoenix.
J. C. de Vos, S. R. Lawry, and C. R. Miller.
Available from the National Technical Information Service, Springfield, VA. 22161. Final Report, March 1985. 125 p, 13 fig, 1 tab, 15 ref, 3 append. Contract No. 1-07-32-V0151.

Descriptors: *Water resources development, *Resources management, *Tucson, *Aqueducts, *Ecological effects, Telemetry, Arizona, Mule deer, Javelina, Bobcat, Water conveyance, Coyote, Wildlife conservation, Wildlife management, Central Arizona Project.

Home range sizes were determined using radio telemetry for two javelina (Dicotyles tajacu), 27 mule deer (Odocoilesu hemionus), 4 bobcat (Lynx rufus) and 15 coyote (Canis latrans) along the western route of the proposed Central Arizona Project aqueduct in Pima County, Arizona, from 1982 to 1983. Coyotes had the largest average home range size (11,563 ha), followed by bobcat (4,079 ha), mule deer (2,048 ha), and javelina (289 ha). Areas where proposed aqueducts would impact these species were identified. Methods recommended to mitigate these impacts were wildlife fencing, crossing structures, water sites, land acquisition, minimizing construction disturbance, and patrolling construction areas. Monitoring kit fox responses to construction was recommended. (Author's abstract)
W87-00889

SHORT-TERM EFFECTS OF ARTIFICIAL OASES ON WILDLIFE,
Arizona Cooperative Wildlife Research Unit, Tucson.
For primary bibliographic entry see Field 3B.
W87-00891

ENVIRONMENTAL IMPACT STATEMENT: TALLAHASSEE-LEON COUNTY WASTEWATER MANAGEMENT, TALLAHASSEE, LEON COUNTY, FLORIDA.
Environmental Protection Agency, Atlanta, GA. Region IV.
For primary bibliographic entry see Field 5D.
W87-00920

TWO-DIMENSIONAL TIDAL MODELS FOR THE DELTA WORKS,
RAND Corp., Santa Monica, CA.
For primary bibliographic entry see Field 2L.
W87-00932

PREDICTIVE SALINITY MODELING OF THE OOSTERSCHELDE WITH HYDRAULIC AND MATHEMATICAL MODELS,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 2L.
W87-00933

IMPACT ASSESSMENT REPORT: C.P. CRANE STEAM ELECTRIC STATION AQUATIC MONITORING PROGRAM,
Martin Marietta Corp., Baltimore, MD. Environmental Center.
For primary bibliographic entry see Field 5C.
W87-00943

INTERVENTION ANALYSIS OF POWER PLANT IMPACT ON FISH POPULATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. P. Madenjian, D. J. Jude, and F. J. Tesar.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 4, p 819-829, April 1986. 6 fig, 5 tab, 26 ref.

Descriptors: *Environmental effects, *Powerplants, *Fish, Alewife, Yellow perch, Perch, D. C. Cook Nuclear Power Plant, Michigan, Lake Michigan.

Alewife (Alosa pseudoharengus) and yellow perch (Perca flavescens) abundances, estimated from monthly gillnet and trawl catches at two transects, were monitored before (1973-74) and during (1975-82) operation of the D.C. Cook Nuclear Power Plant, southeastern Lake Michigan. Intervention analysis, a technique which accounts for autocorrelated observations, and analysis of variance (ANOVA) were applied to the monitoring data to assess any plant impact beginning in 1975. Both analyses disclosed no significant power plant impacts except for gillnetted yellow perch adults. The ANOVA indicated a significant decrease in abundance at the plant-discharge transect relative to the reference transect as plant operation began, which established a plant effect; intervention analysis showed no change. When April and May catches (month of low abundance) were deleted, this plant effect was insignificant. Monte Carlo simulation showed that as the first-order autoregressive coefficient increased positively, type I error of the ANOVA F-tested increased. However, ANOVA was more powerful than intervention analysis when a first-order autoregressive component was included. Impact assessment based only on ANOVA can result in detection of impact when actually there was no effect (type I error) when observations are serially correlated (lack independence). (Author's abstract)
W87-01247

INFLUENCE OF THE KARST SPRING SUBMERGENCE ON THE KARST AQUIFER REGIME,
Karst Water Research Inst., Trebinje (Yugoslavia).
For primary bibliographic entry see Field 2F.
W87-01268

SPATIAL DISTRIBUTION OF ENTRAINED FISH LARVAE IN A POWER PLANT DISCHARGE CANAL,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 8I.
W87-01274

DEMISE OF MEROMIXIS IN RIVERINE LAKES OF THE WORLD HERITAGE WILDERNESS OF SOUTH-WEST TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W87-01458

ARCHAEOLOGICAL INVESTIGATIONS AT HISTORIC SITES IN THE CHOKE CANYON RESERVOIR, SOUTHERN TEXAS,
Texas Univ. at San Antonio. Center for Archaeological Research.
A. A. Fox.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86-184280, A07 in paper copy, A01 in microfiche. Choke Canyon Series: Volume 12, 1986. 122 p, 39 fig, 3 tab, 98 ref, 2 append.

Descriptors: *Archaeology, *Choke Canyon Reservoir, *Texas, History, Reservoir sites, Architecture, Water resources development.

Between July 8 and August 13, 1981, archaeologists from the Center for Archaeological Research (CAR), The University of Texas at San Antonio (UTSA), conducted archaeological investigations at eight historic sites at Choke Canyon Reservoir in Live Oak and McMullen Counties, Texas. The

excavations were part of Phase II cultural resource investigations undertaken by the CAR-UTSA for the United States Bureau of Reclamation. Phase II investigations were the culmination of 14 years of surveys and test excavations carried out in preparation for the construction of the reservoir. A number of different types of structures were investigated, the purpose being to extract as much information as possible about architecture, life styles, and settlement patterns during the last half of the 19th century within the reservoir. These structures included a dugout, log cabins, and small frame houses inhabited by the first settlers in the area, and their children as they grew to maturity, as well as homes of ranch employees toward the turn of the century. Artifacts recovered helped recreate the life of the people, demonstrating how they met the challenges of living in a frontier area, and how life changed after the Civil War and the coming of law and order, railroads, and modern communications. (Lantz-PTT)
W87-01764

PREHISTORIC SITES AT CHOKE CANYON RESERVOIR, SOUTHERN TEXAS: RESULTS OF PHASE II ARCHAEOLOGICAL INVESTIGATIONS,
Texas Univ. at San Antonio. Center for Archaeological Research.
G. D. Hall, T. R. Hester, and S. L. Black.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86-184264, A99 in paper copy, A01 in microfiche. Choke Canyon Series, Volume 10, 1986. 592 p, 108 fig, 59 tab, 113 ref, 7 append.

Descriptors: *Archaeology, *Choke Canyon Reservoir, *Texas, History, Reservoir sites, Architecture, Water resources development, Frio River.

Archaeology was investigated at 72 prehistoric sites located in the basin of Choke Canyon Reservoir on the Frio River in Live Oak and McMullen Counties, southern Texas. The sites will be affected by a lake formed after construction of Choke Canyon Dam, a project of the United States Bureau of Reclamation (USBR). The research was sponsored by the USBR as the second and final phase of a two-stage program of archaeological investigations designed to mitigate damage or destruction of cultural resources resulting from dam construction and subsequent long-term inundation of a large area of the Frio River Valley. (Author's abstract)
W87-01765

ARCHAEOLOGICAL INVESTIGATIONS AT 41 LK 201, CHOKE CANYON RESERVOIR, SOUTHERN TEXAS,
Texas Univ. at San Antonio. Center for Archaeological Research.
C. L. Highley.
Available from the National Technical Information Service, Springfield, VA. 22161 as BP86-184272, A13 in paper copy, A01 in microfiche. Choke Canyon Series: Volume 11, 1986. 270 p, 50 fig, 39 tab, 75 ref, 7 append.

Descriptors: *Archaeology, *Choke Canyon Reservoir, *Texas, History, Reservoir sites, Architecture, Water resources development, Carbon radioisotopes, Radioactive dating.

Two phases of archaeological investigations were carried out by the Center for Archaeological Research, The University of Texas, in the Choke Canyon Reservoir region in south Texas. Sponsored by the U.S. Bureau of Reclamation, the investigations were necessitated by the impending dam construction and subsequent filling of the reservoir. During Phase I, numerous prehistoric sites were recorded and tested. As a result, several sites were recommended for additional excavations during Phase II. Site 41 LK 201 was selected for intensive investigations because it contained both Archaic and Late Prehistoric cultural remains, was well stratified, and contained preserved charcoal and faunal samples throughout the occupational zones. Phase II excavations were designed to expose the stratified components both horizontally and vertically. The Archaic deposits included a series of burned rock features which provided wood charcoal suitable for radiocarbon dating. Radiocarbon dates for Middle and Late Archaic deposits ranged from 1300 B.C. to 480 B.C. Diagnostic artifacts were limited to a few dart points and gougelike tools. (Lantz-PTT)
W87-01766

7. RESOURCES DATA

7A. Network Design

STUDY OF THE RELATIONSHIP BETWEEN WATER QUALITY AND SEDIMENT TRANSPORT: A GUIDE FOR THE COLLECTION AND INTERPRETATION OF SEDIMENT QUALITY DATA,
For primary bibliographic entry see Field 2J.
W87-00948

MONITORING AGRICULTURAL CHEMICALS IN ESTUARIES,
For primary bibliographic entry see Field 5A.
W87-00967

ADJUSTMENT-EQUATIONS TO CALCULATE ION-CONCENTRATIONS, ILLUSTRATED BY CERTAIN GAUGING STATIONS OF THE RIVER WESER (ANSAETZE ZUR KALKULATION VON IONENKONZENTRATIONEN, DARGESTELLT FUER AUSGEWAEHLTE MESSSTATIONEN DER WESER),
Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-01337

MODELS TO MINIMIZE MONITORING,
Institute for Marine Environmental Research, Plymouth (England).
P. J. Radford, and J. West.
Water Research WATRAG, Vol. 20, No. 8, p 1059-1066, August 1986. 9 fig, 9 ref. E.K. Dept. of the Environment Contract Nos. DGR 480/48 and PECD7/7/077-139/82.

Descriptors: *Model studies, *Water quality control, *Monitoring, *Estuaries, Seasonal variation, Path of pollutants, Fate of pollutants, Severn Estuary, England, Mathematical studies, Data acquisition, Data interpretation.

Attempts to monitor changes in the mean concentration of pollutants in estuaries are hampered by the inherent and large seasonal variance induced by the annual pattern of river run-off. Simple models can predict this dilution effect leaving a much smaller variance against which to test for pollution events or gradual changes. An efficient method based on control charts may then be used to test for significant departures from historical performances permitting a relatively rapid response to be made to undesirable changes. Cumulative sum techniques may also be used to test for inconsistencies between model and calibration data leading to better prediction and therefore more sensitive control of estuarine pollution. These techniques are illustrated using salinity and dissolved cadmium data for the Severn Estuary. These control chart techniques are able to make the most of any monitoring data which may be available and can provide some guidance on the frequency of sampling required to detect a specified change in the system. In practice this is dictated by economic and logistical considerations together with an appreciation of the effect of the retention time (or flushing time) of the estuary. If a monitoring scheme for the Inner Estuary is to pick up a single major pollution event which could occur at any random time, then sampling frequency must be of the order of 30-40 days, 10/12 a year. Further down the estuary, the retention time increases to 150-200 days for the Inner Channel which could allow a reduced sampling of 2-4 times a year. If however it is more important to detect small but persistent increases in pollutant levels, then this kind of frequency could be adequate throughout the estuary. (Lantz-PTT)
W87-01477

REGIONAL HYDROLOGIC ANALYSIS: 1. ORDINARY, WEIGHTED, AND GENERALIZED LEAST SQUARES COMPARED,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W87-01536

INTERIM STATUS GROUND WATER MONITORING SYSTEM ASSESSMENTS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
R. M. Melvin, E. L. Hockman, J. E. Cibrik, and M. A. Nelson.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 180-185, 2 tab.

Descriptors: *Groundwater quality, *Water pollution control, *Monitoring, *West Virginia, *Water quality control, Regulations, Impoundments, Landfills, Waste disposal, Aquifers, Hydrogeology, EPA, Groundwater pollution.

The Code of Federal Regulations (40 CFR 265, Subpart F) requires that the owners or operators of surface impoundments, landfills or land treatment facilities that are used to manage hazardous waste, implement a groundwater monitoring program capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility. These monitoring systems were required to be installed by November 19, 1981. U.S. EPA is currently cooperating with state regulatory agencies in order to assess how these monitoring systems fulfill these interim status requirements. The authors were responsible for review of groundwater monitoring systems at facilities throughout West Virginia. The information compiled from the assessment reports, which were written for each of the monitoring systems reviewed, correlates the monitoring well construction, placement and hydrogeologic setting with interim status regulatory requirements. Inadequate initial site hydrogeologic investigation, combined with lack of guidance from regulatory agencies, led to design errors in the monitoring well systems installed. These results show a need for coordination between the regulators owners or operators of hazardous waste management facilities and the contracted consultants prior to entering the design phase for monitoring well systems. (See also W87-01669) (Author's abstract)
W87-01689

GROUND WATER MONITORING SYSTEM DESIGN IN A COMPLEX GEOLOGIC SETTING,
Conversion Systems, Horsham, PA.
R. D. Buller, A. Gradet, and V. S. Reed.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 186-194, 9 fig, 1 tab, 2 ref.

Descriptors: *Groundwater quality, *Monitoring, *Geohydrology, Legislation, Water quality control, Water quality standards, Groundwater movement, Aquifers, Texas, Hazardous wastes.

Federal and state hazardous waste regulations specify the design criteria for groundwater monitoring programs in response to the Resource Conservation and Recovery Act (RCRA). In some geologic settings, these criteria can be directly applied to the monitoring program design. However, interpretation of groundwater monitoring standards in a complex geologic setting is often not straightforward. As the complexity of the geologic setting increases, the interpretation and application of the monitoring system standards become more complex. Four elements in the federal and state standards were found to be crucial in the design of a monitoring system for a hazardous waste landfill: (1) Definition of the direction of groundwater flow; (2) Definition and identification of the upper-

most aquifer; (3) Location of the point of compliance; and (4) Downgradient well spacing. This paper reviews the design of a groundwater monitoring program for a proposed hazardous waste facility located in the Upper Gulf Coast of Texas. Emphasis is placed on presentation of techniques used to resolve the four primary issues. (See also W87-01669) (Author's abstract)
W87-01690

BACKGROUND GROUND WATER QUALITY MONITORING: TEMPORAL VARIATION,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5G.
W87-01695

CONVERSION OF RESOURCE EXPLORATION HOLES TO MONITORING WELLS,
Bechtel Energy Corp., Memphis, TN.
E. M. Smith, and S. W. Gowan.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 279-282, 4 fig.

Descriptors: *Monitoring, *Wells, *Geohydrology, Exploration, Coal, Lignite, Uranium, Case histories, Cost-benefit analysis, Groundwater potential.

Exploration programs for resources, such as coal, lignite and uranium typically involve the drilling and geophysical logging of hundreds and sometimes more than a thousand test holes. While the data from the program is well used for resource identification and evaluation, it is seldom fully utilized to obtain information on hydrogeologic conditions. Usually a separate field program is made several years later and at increased cost to obtain this information. A brief summary of a case history was presented in which the exploration program and groundwater monitoring programs were combined. This conjunctive effort enabled a detailed understanding of the groundwater conditions to be made simultaneously with the resource evaluation. The result was a lower cost for the monitoring well program than had it been performed years later, and an increase in groundwater data for the project area. It is proposed that, when feasible, an exploration program for resource evaluation should be combined with a groundwater monitoring program. Such a combined effort would result in an optimization of data and cost. (See also W87-01669) (Lantz-PTT)
W87-01700

FIELD MONITORING OF THE ADAMS, MASSACHUSETTS LANDFILL LEACHATE PLUME,
For primary bibliographic entry see Field 5B.
W87-01711

MONITORING NETWORKS AND HYDROLOGIC BUDGET FOR EVALUATING A LEACHATE CONTROL SYSTEM IN A LANDFILL IN CALIFORNIA,
California State Univ., Fullerton. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-01712

7B. Data Acquisition

SUMMARY OF THE NINETEENTH MEETING OF THE INTERAGENCY ADVISORY COMMITTEE ON WATER DATA.
Geological Survey, Reston, VA. Water Resources Div.
October 16-18, 1985, Knoxville, Tennessee. 1985. 42 p, 5 append.

Descriptors: *Water policy, *Data collections, Groundwater, Water quality, Water use, Data acquisition, Public policy, Information exchanges.

This report presents information exchanged via two panel discussions, the first of which concerned selected data programs, activities, and strategies. Speakers from the Tennessee Valley Authority, Environmental Protection Agency, Geological Survey, Bureau of Reclamation, Corps of Engineers, and the National Weather Service gave presentations concerning groundwater and water quality efforts in their respective agencies. The second panel discussed uses of water data by various agencies. Representatives of the Forest Service, Office of Surface Mining, and the Bureau of Indian Affairs, reported on water data uses and water data collection efforts. A report of the 1985 meeting of the Advisory Committee on Water Data for Public Use was also given. Prior to adjournment, a general session was held in which attendees asked questions and voiced opinions concerning water data collection and coordination activities. (Lantz-PTT)
W87-00882

PRECIPITATION GAGE DATA COLLECTION AND ANALYSIS IN SUPPORT OF SCPP: INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 2B.
W87-00887

WIPP HYDROLOGY PROGRAM WASTE ISOLATION PILOT PLANT SOUTHEASTERN NEW MEXICO: HYDROLOGIC DATA REPORT 2.
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 2F.
W87-00952

IRRIGATED LANDS ASSESSMENT FOR WATER MANAGEMENT: TECHNIQUE TEST,
California Univ., Berkeley. Remote Sensing Research Program.
S. L. Wall, C. E. Brown, M. Ericksson, C. A. Grigg, and R. W. Thomas.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-17921, Price codes: A15 in paper copy, A01 in microfiche. NASA Contractor Report 166370, April 1981. 329 p, 77 fig, 60 tab, 14 ref, 5 append. NASA Cooperative Agreement NCC 2-54.

Descriptors: *Remote sensing, *Irrigation, *Data collections, *Satellite technology, Landsat, Mapping, Agriculture.

A procedure for estimation of irrigated land using full frame Landsat imagery and a sample of ground data was demonstrated statewide in California in 1979. A map of land irrigated at least once during the calendar year was produced. This was 9.86 million acres, a figure within 0.5% of the value obtained from conventional ground mapping and sampling techniques. For a ground sampling system to achieve the same error as the Landsat system, 3 to 5 times the number of ground samples would be required in addition to the added cost of preparing the map. A computer classification of Landsat digital data to land categories was further developed. Differences between manual and computer techniques varied from 0.3% in Sacramento County to 10.8% in Kings County. (Cassar-PTT)
W87-00953

APPLICATION OF CO2-POROMETER METHODS TO ASSESSMENT OF COMPONENTS OF PHOTOSYNTHETIC PRODUCTION IN ESTUARINE ECOSYSTEMS,
Instituto Botanico, Lisbon (Portugal).
For primary bibliographic entry see Field 2L.
W87-01053

CARBON AND NITROGEN CONTENT OF NATURAL PLANKTONIC BACTERIA,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 5A.
W87-01077

REMOTE SENSING OF COASTAL WETLANDS,
Scranton Univ., PA. Dept. of Biology.
M. A. Hardisky, M. F. Gross, and V. Klemas.
Bioscience, Vol. 36, No. 7, p 453-460, July-August 1986. 4 fig, 3 tab, 48 ref. NOAA Sea Grant NA85AA-D-SG033 (Project A/I-20), NASA Biospherica Research Grant NAGW-374, NSF Grant DAR-8017836.

Descriptors: *Coastal vegetation, *Remote sensing, *Mapping, *Satellite technology, *Biomass, *Productivity, High-altitude sensors, Imaging spectrometery, Aerial photography, Landsat, SPOT satellites, Stress, Plant pathology, Plant physiology, Radiometers, Multispectral scanners, Thematic mappers.

Mapping coastal vegetation, spectral estimation of biomass and productivity, high altitude sensors, and imaging spectrometry are reviewed in relation to wetlands research applications. Aircraft film cameras offer higher spatial resolution and low cost for mapping precise locations of small wetland areas as required by wetlands protection acts. For mapping larger areas, satellites such as Landsat and SPOT (Systeme Probatoire d'Observation de la Terre) offer cost advantages, especially for large-scale land use or vegetation surveys. NOAA's AVHRR has a spatial resolution of only 1 km, which is useful for mapping entire continents, but cannot resolve typical wetland features. Detecting vegetative stress and biomass requires considerable spectral resolution, at present provided only by multispectral scanners and imaging spectrometers. Hand-held radiometers have been used extensively to assess biomass and net aerial primary productivity of small wetland tracts and they also have proven valuable for evaluating biomass from aircraft. The spatial resolution of Landsat's multispectral scanner is often too poor to predict biomass, but airborne multispectral scanners, thematic mappers, and SPOT show great promise for this purpose. (Rochester-PTT)
W87-01093

PROCESSING OF GEOPHYSICAL WELL LOGS BY MICROCOMPUTERS AS APPLIED TO THE SOLUTION OF HYDROGEOLOGICAL PROBLEMS,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
G. -A. Tselentis.
Journal of Hydrology JHYDA7, Vol. 80, No. 3/4, p 215-236, October 15, 1985. 12 fig, 2 tab, 18 ref.

Descriptors: *Well logs, *Microcomputers, *Hydrogeology, *Geophysical data, *Borehole geophysics, Logging, Log sampling, Groundwater flow.

Recent developments in microelectronic technology have provided very powerful microcomputers for use at the well site by hydrogeologists or geophysicists to provide timely answers to important hydrogeological questions. A brief and generalized description of the philosophy and the problems associated with the application of microcomputers to the organization and processing of borehole geophysical measurements to evaluate various hydrogeological problems is presented. It is possible for the microcomputer to handle complex analytical processes which may be used to advantage by the well log analyst in many hydrogeological problems. Geophysics linked to the data-handling facilities of microcomputers, offers a powerful and underdeveloped logging technology that is ripe for development as a low-cost quantitative investigation technique. (Khumbatta-PTT)
W87-01189

PARTIAL AREA HYDROLOGY AND REMOTE SENSING,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
A. Van de Griend, and E. T. Engman.
Journal of Hydrology JHYDA7, Vol. 81, No. 3/4, p 211-251, November 15, 1985. 12 fig, 3 tab, 170 ref.

Descriptors: *Partial area hydrology, *Rainfall-runoff relationships, *Remote sensing, Hydrologi-

cal systems, Runoff, Electromagnetic spectrum, Sensors, Satellite technology, Watershed studies.

The partial-area concept is one of the basic concepts in modelling hydrologic processes which are related to the fast components of runoff production. The main reasons why this concept has not been applied in practical hydrology, are related to the temporal and spatial variability of those contributing areas, which make their identification and characterization extremely difficult. This identification has only been realized by detailed field surveys. Remote sensing has developed into a most promising technique for regional analysis of both small and large scale hydrological systems. The potential applications of remote sensing for partial-area hydrology are discussed for the various bands of the electromagnetic (E.M.) spectrum. The spatial and temporal aspects of remote sensing form a potential source of new information which has not been used to any degree. It is concluded that optimum use of the remotely sensed data requires a change in hydrological modelling, and appropriate adaption of models. (Author's abstract)
W87-01198

GEOSTATISTICAL ANALYSIS OF GEOELECTRIC ESTIMATES FOR SPECIFIC CAPACITY,
Tiszadata Consulting Engineers, Budapest (Hungary).
For primary bibliographic entry see Field 2F.
W87-01265

HOW REPRESENTATIVE ARE THE DATA SETS USED TO DERIVE NATIONAL WATER QUALITY CRITERIA,
EA Engineering, Science, and Technology, Inc., Northbrook, IL.
For primary bibliographic entry see Field 5G.
W87-01322

ANALYSIS AND MODELLING OF RUNOFF IN THE SAHEL REGION (OURSI POND, BURKINA FASO) (ANALYSE ET MODELISATION DU RUISSELLEMENT EN REGION SAHELIENNE (MARE D'OURSI, BURKINA FASO),
Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast). Centre d'Adiopodoume.
For primary bibliographic entry see Field 2B.
W87-01333

STRUCTURAL CONDITIONS OF THE CARBONATE AQUIFERS IN SOUTHERN CHINA (GUANGXI PROVINCE, GUILIN AREA), (CONDITIONS STRUCTURALES DES AQUIFERES CARBONATES DE CHINE MERIDIONALE (PROVINCE DE GUANGXI, REGION DE GUILIN)),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2F.
W87-01346

CALIBRATION OF A DUAL-ENERGY GAMMA RADIATION SYSTEM FOR MULTIPLE POINT MEASUREMENTS IN A SOIL,
Alabama Agricultural Experiment Station, Auburn.
For primary bibliographic entry see Field 2G.
W87-01451

SIMPLE AND INEXPENSIVE MONITOR FOR RECORDING OXYGEN AND TEMPERATURE IN LAKES AND RESERVOIRS,
King's Coll., London (England). Dept. of Human Environmental Science.
A. W. Bark, D. W. Cartwright, C. S. Lovatt, and J. M. Watts.
Water Research WATRAG, Vol. 20, No. 8, p 1005-1010, August 1986. 4 fig, 5 ref.

Descriptors: *Monitoring, *Oxygen, *Water quality, *Temperature, *Reservoirs, Lakes, Water quality control, Transducers, Sensors, Electronic equipment, Cost analysis.

The design of a simple and inexpensive monitor for the continuous recording of oxygen and temperature at multiple depths in small lakes and reservoirs. The design allows additional depths to be monitored by simply adding additional sensor units. All of the components, except the sensor assemblies, are housed on a raft with a waterproof cover. The sensors are suspended in the water from the raft. The submerged oxygen electrode assemblies allow full equilibration but the flow system onto the raft permits the ready incorporation of other types of transducer, so that other variables can be measured. Such transducers would not need to be fully submersible. The monitor proved robust and reliable and was simple to operate and calibrate in the field. The total cost of the system, excluding construction and development time, did not exceed 2500 pounds. Of this, the data logger and oxygen electrodes accounted for about 2000 pounds, and the pumps and motor a further 300 pounds. The remaining 200 pounds was used for electronic components, lead/acid batteries and materials for the raft. Running costs are minimal as rechargeable batteries are employed throughout and the oxygen electrodes are fully user serviceable. (Lantz-PTT)
W87-01469

ESTIMATION OF TDS IN SAND AQUIFER WATER THROUGH RESISTIVITY LOG,
China Geoexploration and Waterwell Engineering Corp., Karachi (Pakistan).
For primary bibliographic entry see Field 2F.
W87-01490

COMPUTER PROGRAM FOR GENERATING TWO-DIMENSIONAL FIELDS OF AUTOCORRELATED PARAMETERS,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
A. I. El-Kadi.
Ground Water GRWAAP, Vol. 24, No. 5, p 663-667, September-October, 1986. 3 fig, 9 ref, append.

Descriptors: *Computer programs, *Mathematical models, *Groundwater movement, *Hydraulic properties, Hydraulic conductivity, Aquifers, Monte Carlo Method, Mathematical studies.

A computer program is described which generates two-dimensional fields of autocorrelated parameters. The program is written for parameters which are log-normally distributed, such as the hydraulic conductivity of aquifers. A specific form for the autocorrelation structure is included. Generating a parameter field represents an important step in the stochastic analysis of groundwater flow and mass transport via the Monte-Carlo technique. The program is written in FORTRAN for both the IBM PC and the VAX 11/780, and runs interactively to allow easy use. The program listing as run on the IBM PC is included. (Author's abstract)
W87-01498

MICROCOMPUTER PACKAGE FOR DETERMINING OPTIMAL WELL DISCHARGE,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
G. N. Paudyal, and A. Das Gupta.
Ground Water GRWAAP, Vol. 24, No. 5, p 668-673, September-October, 1986. 1 tab, 9 ref, 2 append.

Descriptors: *Computer programs, *Microcomputers, *Wells, *Discharge, Pump wells, Pumping tests, Computers, Mathematical studies, Algorithms.

A fully interactive microcomputer package consisting of two BASIC programs, OPTP and PTEST, is presented for determining optimal well discharge. Program PTEST computes the coefficients and exponent of the nonlinear drawdown equation, using three-step data from a step-drawdown pumping test. Program OPTP computes the optimal discharge using a single-variable, constrained, nonlinear programming algorithm. The package, originally written for an IBM-PC, can be adapted to any microcomputer with minor modifications. (Author's abstract)
W87-01499

EFFECT OF SALINITY AND IONIC COMPOSITION ON EVAPORATION: ANALYSIS OF DEAD SEA EVAPORATION PANS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 2D.
W87-01527

RADAR-BASED STOCHASTIC MODEL FOR SHORT-TIME-INCREMENT RAINFALL,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W87-01537

TERRESTRIAL OBSERVATIONS FROM NOAA OPERATIONAL SATELLITES,
National Environmental Satellite, Data, and Information Service, Washington, DC.
H. Yates, A. Strong, D. McGinnis Jr, and D. Tarpley.
Science SCIEAS, Vol. 231, No. 4737, p 463-470, January 31, 1986. 12 fig, 35 ref.

Descriptors: *Remote sensing, *NOAA, *Satellite technology, Oceanography, Hydrology, Agriculture, Snow cover, Sea ice, Ice, River systems, Precipitation, Temperature.

Important applications to oceanography, hydrology, and agriculture have been developed from operational satellites of the National Oceanic and Atmospheric Administration (NOAA), and are expanding rapidly. Areas of interest involving the oceans include sea surface temperature, ocean currents, and ocean color. Satellites can monitor various changing hydrological phenomena, including regional and global snow cover, river and sea ice extent, and areas of global inundation. Agriculturally important observations derived from operational satellites include precipitation, daily temperature extremes, canopy temperatures, insolation, and snow cover. This overview describes the current status of each area. (Doria-PTT)
W87-01577

IMPORTANCE OF THE CONVERGENCE CRITERION IN THE AUTOMATIC CALIBRATION OF HYDROLOGICAL MODELS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2A.
W87-01585

DISJUNCTIVE KRIGING 3. COKRIGING,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 2G.
W87-01586

LOW-VELOCITY MEASUREMENT IN WATER,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
C. Ellis, and H. G. Stefan.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1480-1486, September 1986. 7 fig, 14 ref.

Descriptors: *Flow velocity, *Flow measurement, *Measuring instruments, *Velocity, *Optical hydrogen bubble-tracing techniques, *Tracking techniques, Data acquisition, Rotating propeller, Hot film method, Lasers, Doppler, Electromagnetic waves, Tracers.

Water velocities in the centimeter per second range or less are measurable by only a few instruments. Experimental laboratory studies frequently require such measurements. A review of low water velocity measurement methods is presented (rotating propeller, hot wire or hot film method, laser Doppler anemometry, electromagnetic current meters, and tracer studies). An inexpensive optical

hydrogen bubble-tracing technique is described for velocity measurements in the range 0.5 to 8 cm/s. Modification to a thymol blue (pH) tracer method extends its applicability to the range 0.1 to 1.0 cm/s. Design and operational characteristics of the hydrogen bubble/thymol blue current meter are described. (Author's abstract)
W87-01598

NWWA CONFERENCE ON SURFACE AND BOREHOLE GEOPHYSICAL METHODS IN GROUND WATER INVESTIGATIONS.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 2F.
W87-01641

GEOELECTRIC DELINEATION OF A COASTAL RIDGE AQUIFER,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W87-01642

AUTOMATED D.C. RESISTIVITY SYSTEM,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2F.
W87-01643

SELECTION OF PROPER SURFACE RESISTIVITY TECHNIQUES AND EQUIPMENT FOR EVALUATION OF GROUNDWATER CONTAMINATION,
JRB Associates, Inc., McLean, VA.
For primary bibliographic entry see Field 5B.
W87-01644

APPLICATION OF AN AUTOMATIC EARTH RESISTIVITY SYSTEM FOR DETECTING GROUND WATER MIGRATION UNDER A MUNICIPAL LANDFILL,
Southwest Research Inst., San Antonio, TX.
D. L. Laine, J. O. Parra, and T. E. Owen.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 34-51, 14 fig, 2 ref.

Descriptors: *Groundwater movement, *Geophysical surveys, *Resistivity, *Landfills, *Municipal wastes, Geophysics, Geohydrology, Data acquisition, Data interpretation, Contours, Computers, Sounding, Path of pollutants, Leaching, Saturation.

Surface geophysical methods can add valuable information to the geologic data base for a given waste disposal site. One of the most widely used methods is the ground electrode resistivity survey. However, most resistivity equipment requires a labor-intensive effort in collecting field data, which is time consuming and expensive for gathering the large amount of data needed. The system reported here has the advantage of automatically collecting and recording resistivity data along a traverse line in a fraction of the time required by conventional equipment. This system was used to collect 1700 meters of resistivity data over a municipal landfill during the month of July, 1984. The data was processed on a Hewlett-Packard 9000 and Hewlett-Packard 9826 mini-computer programmed to invert resistivity data assuming horizontal layering. Resistivity values were corrected for surface terrain roughness using manually entered elevation data. The resistivity survey conducted at the municipal landfill demonstrated that the grounded electrode resistivity method can be used to: (1) develop iso-resistivity maps; (2) draw resistivity pseudosections; and (3) provide Schlumberger depth sounding information. This information can be used as an aid in developing a drilling and leachate recovery program. Interpretations and analysis of the municipal landfill survey data show that the resistivity trend indicated in the deeper iso-resistivity contour maps are attributed to the North-South fault/fracture zone. Sump zones are indicated as low resistivity values on the iso-resistivity values on the contour maps. Because sump zones are areas where water will tend to pool, drilling results should indicate areas of high water content and thus build confidence in the resistivity technique and its interpretations. Schlumberger depth soundings developed from the pole-dipole resistivity survey indicated: (1) depth of fill material; (2) thickness of Austin Chalk below the fill; and (3) depth to the top of the Eagle Ford Shale. However, because of lateral variations in the fill material, reliable Schlumberger depth soundings were developed for only a few of the resistivity traverse lines. (See also W87-01641) (Lantz-PTT)
W87-01645

TERRAIN CONDUCTIVITY AS A TOOL FOR DELINEATING HYDROCARBON PLUMES IN A SHALLOW AQUIFER - A CASE STUDY,
Woodward-Clyde Consultants, Houston, TX.
R. M. Valentine, and T. Kwader.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 52-63, 3 fig, 1 tab.

Descriptors: *Conductivity, *Geophysical surveys, *Hydrocarbons, *Plumes, *Aquifers, *Groundwater pollution, Case studies, Path of pollutants, Water pollution, Chemical wastes, Sand, Clays, Groundwater movement, Leaching, Organic wastes, Seeps, Measuring instruments.

Under favorable site conditions terrain conductivity has proven to be an effective tool for assessing the areal extent and the relative concentrations of contaminants that have a significant conductivity contrast with the native groundwater. In 1983, a hydrocarbon residue was observed collecting at the water table on the bank of a drainage channel adjacent to a small chemical mixing plant. Although the contaminant was identified as a non-hazardous hydrocarbon belonging to the chemical facility, its exact source area was unknown. Shallow terrain conductivity methods (using a Geonics EM-31) were employed to aid in mapping anomalous areas of conductivity. Approximately 6 acres were surveyed on a 20-ft grid in six hours by two geologists. Four areas of apparent low conductivity (less than 0.25 milliohms) were isolated. Results indicate that: 1) Underlying the entire site investigated, at a depth of 10 to 15 ft below land surface, is a white to tan sandy clay which forms the base of the shallow aquifer. The clay is believed to be sufficiently impermeable to protect the underlying aquifer, the main source of potable water in the area; 2) The groundwater gradient is from east to west across the area surveyed; 3) Organics were found in a wide range of concentrations on the six acre site investigated. Data from the terrain conductivity survey indicated the presence of at least three general areas of contamination: two believed to be old inactive disposal areas where resin residuals were disposed and the other, in the vicinity of the production area around the raw materials storage and mixing facilities, includes several smaller concentrations of leakage, spills, or washings; 4) The pit areas appear to be primarily composed of resin residuals; and 5) The source of the 'seep' of material in the ditch west of the site appears to be from the grass area southwest of the raw storage area, between the two entrance driveways. Another seep area may appear north of the original seep if product in the ground, immediately west of the raw storage area migrates toward the ditch. (See also W87-01641) (Lantz-PTT)
W87-01646

GEOPHYSICAL MONITORING OF AN INJECTED CONTAMINANT PLUME: EXPERIMENTS WITH A DISPOSABLE E-LOG,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. P. Greenhouse, L. A. Faulkner, P. E. Pehme, and J. Wong.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 64-82, 6 fig, 1 tab, 5 ref. Grant No. A85537.

Descriptors: *Geophysics, *Geophysical surveys, *Monitoring, *Plumes, *Injection, *Disposable E-log, Alliston, Ontario, Canada, Sample wells, Chlorides, Bromides, Groundwater pollution, Water pollution control, Water quality management.

In August of 1982, 12 cu m of contaminated water was injected into a sandy aquifer at Canadian Forces Base Borden near Alliston, Ontario. The progress of this slug was monitored for at least 20 months by a dense array of multi-level sampling holes. The initial injection contained 918 mg/l of chloride and 323 mg/l of bromide in addition to a variety of organic and heavy metal tracers, presenting an anomalously conductive target for surface geophysical measurements. This paper reports on two geophysical projects that were initiated as a result of the injection. In the first, the passage of the slug was traced for 8 months using a multi-electrode cable. The second project evolved from the need for detailed information on vertical formation conductivity structure at sites of shallow contamination studies, and at a reasonable cost. The studies indicated that: (1) In the sandy formation of CFB Borden, it is feasible to track an injected plume with these chloride levels for at least 8 months; (2) The ability to reliably map anomalies less than 10% of background is encouraging for projects such as large scale monitoring of sanitary landfill perimeters; (3) The decay of the maximum conductivity anomaly with time is roughly proportional to the decay of peak chloride content with time. The lateral dimensions of the chloride plume are quite well reproduced by the n=3 dipole contour map, but the effective target for the geophysics appears to be a much smaller core volume of the plume; (4) The simple disposable E-log (DEL) concept described here appears to work well in the sandy environment tested; (5) The DEL has the potential to supply the information it was originally designed for, namely, formation conductivities at shallow depths. A second use, not yet well explored, is as an indicator of the lateral continuity of hydrogeological conditions; and (6) Another potential use for the DEL is as the core of a multilevel piezometer. The DEL should be able to operate through the outer web of tubing to provide formation conductivities to complement the water conductivity data. (See also W87-01641) (Lantz-PTT)
W87-01647

APPLICATIONS OF MICROGRAVITY SURVEYS TO SUBSURFACE EXPLORATION,
STS Consultants Ltd., Lansing, MI.
T. K. Dahlstrand.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 85-105, 6 fig, 10 ref, append.

Descriptors: *Microgravity surveys, *Subsurface mapping, *Geophysics, *Gravity studies, Faults, Measuring instruments, Model studies, Surveys, Groundwater management, Field tests, Groundwater movement.

There are many types of geophysical equipment used to explore the shallow subsurface environment. The gravity method, although unfamiliar to some, is valuable tool in studying geologic structures. Despite its common use in the oil and gas industry, the gravity method still accounts for a relatively small percentage of geophysical exploration work. In general, it is the objective of the gravity survey to determine the location, shape and depth of a subsurface structures. Such structures may include faults, bedrock valleys, sink holes or even underground utilities or tunnels. Gravity meter equipment requirements to perform microgravity surveys, the basics of gravity theory, and plans for a field study by constructing an appropriate model to predict the gravity anomaly, are discussed. Calibration methods and four case history applications are presented. Three of the studies were successful and in one case, the microgravity survey did not succeed. The intent of this paper was to offer some insight into the microgravity method and its application to subsurface exploration. The planning, preparation, equipment selection, and field operator skill and patience are all important aspects to a project. Gravity methods continue to offer a method for studying geologic

structures where lateral density variations exist. (See also W87-01641) (Lantz-PTT)
W87-01648

GRAVITY AND SEISMIC REFRACTION MEASUREMENTS FOR DEEP GROUND WATER SEARCH IN SOUTHERN DARFUR REGION, SUDAN,
Kuwait Univ., Safat. Dept. of Geology.
H. O. Ali.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 106-120, 6 fig, 21 ref.

Descriptors: *Gravity studies, *Seismic refraction, *Groundwater potential, Darfur Region, Sudan, Groundwater availability, Subsurface mapping, Data acquisition, Data interpretation, Sedimentary basins, Eddaein, Sandstones.

In the Northern Darfur Region (Sudan), the search for groundwater from deep sources has greatly intensified, especially in Southern Darfur, where appreciable thickness' of Tertiary-Cretaceous sediments exist. Gravity measurements were taken along two profiles (250 km long) to determine the lateral and the vertical extents of the sediments as a part of groundwater search in the Baggara Basin in southern Darfur Region (Sudan). Gravity measurements were aided by seismic refraction to provide depths at specific control points along the profiles. These depths were used to estimate the regional/residual gravity along these profiles. Automatic inversion of gravity residual data has revealed a deep sedimentary basin that reaches 4.0 km at 50 km northeast from Eddaein town. The sediments are less cemented and possibly related to Umm Rawaba formation. The thickness of the basin decreases rapidly SW where it reaches 400 m near Buram town and the sediments are more cemented possibly related to Nubian sandstone and deposited on irregular basement topography. The result of this study has highlighted the suitability of combing gravity and seismic refraction techniques for regional groundwater exploration in arid and semi-arid zones similar Darfur Region. (See also W87-01641) (Lantz-PTT)
W87-01649

SHALLOW SEISMIC REFLECTION METHOD FOR USE IN MAPPING OVERBURDEN STRATIGRAPHY,
Geological Survey of Canada, Ottawa (Ontario).
R. M. Gagne, S. E. Pullan, and J. A. Hunter.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 132-145, 18 fig, 4 ref.

Descriptors: *Seismic waves, *Reflection methods, *Subsurface mapping, *Stratigraphy, Groundwater availability, Seismology, Bedrock, Shallow water, Geophysics, Geologic mapping.

The past four years in engineering seismology have been a period of rapid change. This will continue in the area of instrument and source improvement as well as in the development of field techniques, as the application of shallow reflection seismology in the mapping of surficial materials and bedrock topography, increases. The efforts reported have concentrated on the development of simple low cost techniques with microcomputer-based interpretation, which would prove useful and cost effective for the average geological or geophysical prospecting firm. Field experience has proved that, in favorable areas, it is possible to obtain good high resolution reflections from within unconsolidated overburden, and from the overburden-bedrock interfaces using an engineering seismograph and the 'optimum window' and 'optimum offset' techniques described. These shallow reflection methods can be applied successfully where the ground will transmit frequencies high enough to allow the required structural resolution. In general this condition is satisfied when the water table is close to the surface. In such areas, shallow reflection techniques can provide subsurface structural information that could not be obtained with refraction methods. (See also W87-01641) (Lantz-PTT)
W87-01650

SEISMIC REFLECTION PROFILING IN THE CEDAR RIVER BASIN, WESTERN WASHINGTON,
Arkansas Univ., Fayetteville. Dept. of Geology.
R. W. Lankston, M. M. Lankston, and L. M. West.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 146-164, 12 fig, 1 tab, 5 ref.

Descriptors: *Seismic waves, *Geophysical surveys, *Reflection methods, *Cedar River basin, *Washington, Drilling, Geophysics, Seismology, Data acquisition, Data interpretation, Bedrock, Data processing.

The Cedar River Basin, in the foothills of the Cascade Mountains was being evaluated in 1980 for the Seattle Water Department as a well field site. Drilling in the basin had penetrated 76 m of water-bearing, glacio-fluvial sediments. Additional drilling was planned to test the aquifer system. Bedrock, the base of the aquifer system, was believed to be less than 100 m below the surface. Continuous profiling with the engineering seismic reflection method was conducted in order to determine the depth to the bedrock so that the drilling program could be finalized. A 12-channel, signal enhancement seismograph was used to record data on paper in the field. While one geophysicist was acquiring the data, another geophysicist digitized the paper seismic records at the field office. The processing geophysicist also generated preliminary velocity analyses and demonstrated that usable reflection were being recorded. Data processing completed after field operations included the application of static and dynamic corrections to the data and displaying the data in the form of seismic sections. Data processing and interpretation were complicated by two strong reflections that intersected and crossed over each other. Interpretation of the final seismic section indicated that bedrock was much deeper than had been anticipated. The depth to bedrock at one point was calculated to be 200 m. Subsequent drilling at the location penetrated bedrock at 203 m. With modern data processing software and a 32-bit microcomputer, the data were reevaluated to investigate static correction and signal interference problems that were not resolved in the original processing. The resulting seismic section shows the bedrock reflection more clearly than before. The interpreted depth to the bedrock surface is still within acceptable limits of accuracy for the engineering seismic reflection method. (See also W87-01641) (Lantz-PTT)
W87-01651

MONITORING OF SUBSURFACE CONTAMINANTS WITH BOREHOLE/SURFACE RESISTIVITY MEASUREMENTS,
California Univ., Berkeley. Lawrence Berkeley Lab.
M. J. Wilt, and C. F. Tsang.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 167-177, 4 fig, 6 ref. Contract No. DE-AC03-76SF00098.

Descriptors: *Groundwater pollution, *Borehole geophysics, *Monitoring, *Boreholes, *Resistivity, Model studies, Simulation analysis, Path of pollutants, Groundwater movement, Electrical studies, Geophysics, Case studies, Aquifers, Conductance.

Three-dimensional resistivity modeling was performed to simulate the changes in resistivity due to the leakage of fluid contaminants into an aquifer. The simulation represents a case where the fluid is introduced into a 25 m aquifer at a depth of 45 m. The contaminant fluid is assumed to be electrically more conductive than the in-situ groundwater. Resistivity measurements were simulated using a finite difference algorithm to calculate potentials for an arbitrary three-dimensional resistivity distribution with surface and downhole current and potential electrodes. A downhole/surface array was considered where current was injected at the aquifer depth and voltage measurements were made on the surface. Cases were considered where current was injected at a point within the contaminant plume as well as outside of the plume (offset case). Also considered were three contaminant distributions: case 1, the contaminant plume forms a uniform cylinder centered around the injection well; case 2, the plume forms a nonuniform cylinder around the well where contaminant concentration decreases away from the well; case 3, the aquifer has a variable vertical permeability. Results indicate that the anomaly is much greater using the downhole electrode than for surface arrays, and that the data may be used to roughly characterize the contaminant mass and its boundaries. Several cases involving different contaminant boundaries were studied and show that the downhole/surface measurements are not very sensitive to differences in the boundary geometry although a rough determination of the boundary position is possible. For the case where the downhole current electrode is located outside of or at the edge of the contaminant, the anomaly size is smaller but the shape allows for good discrimination of the near-side boundary. (See also W87-01641) (Lantz-PTT)
W87-01652

CORRELATION BETWEEN FIELD GEOPHYSICAL MEASUREMENTS AND LABORATORY WATER SAMPLE ANALYSIS,
Technos, Inc., Miami, FL.
For primary bibliographic entry see Field 5B.
W87-01653

ROLE OF GEOLOGICAL AND GEOPHYSICAL DATA IN MODELING AN ALLUVIAL BASIN, SOUTHWEST NEW MEXICO,
Harding-Lawson Associates, Novato, CA.
K. M. O'Brien, and W. J. Stone.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 198-214, 13 fig, 27 ref. Agreement No. 14-08-0001-18812.

Descriptors: *Geophysics, *Geohydrology, *Model studies, *Gravity surveys, *Alluvial basins, *New Mexico, *Data interpretation, Subsurface mapping, Geologic mapping, Driller log, Pumping tests, Transmissivity, Groundwater movement, Calibrations.

A parameter-estimation technique based on existing hydrological, geophysical, and geological data was developed to approximate transmissivity values for use in a groundwater flow model of the Animas Valley, southwest New Mexico. Complete Bouguer gravity anomaly maps together with seismic-refraction profiles, geologic maps, geologic geophysical, and drillers' logs, water levels, and pumping-test data provide insight into the transmissivity of bolson deposits throughout the basin. The transmissivity distribution was primarily based on reported pumping and specific-capacity tests in conjunction with complete Bouguer gravity anomaly maps and well-log data. Reported transmissivity values were characterized by gravity values and well-log data. In grid blocks lacking pumping and specific-capacity tests, transmissivity values were assigned based on the relationship of gravity values and well-log data within other grid blocks for which transmissivity values are available. A two-dimensional, finite-difference, groundwater flow, computer codes was used to evaluate the effectiveness of the parameter-estimation technique. Although the trial-and-error method of calibration was employed, the actual computer time necessary for model calibration was minimal. The conceptually straightforward approach for parameter estimation utilizing existing hydrological, geophysical, and geological data provides realistic parameter estimates. (See also W87-01641) (Author's abstract)
W87-01654

COMPARATIVE ANALYSIS OF SURFACE RESISTIVITY SURVEYS AND NATURAL-GAMMA RADIATION BOREHOLE LOGS IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.

P. C. Reed.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 215-227, 6 fig, 9 ref.

Descriptors: *Resistivity, *Geophysical surveys, *Gamma radiation, *Borehole geophysics, *Illinois, *Groundwater quality, Alluvial sediments, Electrical studies, Bedrock, Geophysics, Sounding.

Groundwater supplies in the western, central and southern parts of Illinois are often of marginal quality for farm, domestic and municipal use. The Illinois State Geological Survey has conducted approximately 50 electrical earth resistivity surveys yearly, in the search for adequate supplies of groundwater in the glacial drift and alluvial sediments that overlie the bedrock throughout much of the state. Surface geoelectrical studies have proven useful in delineating sand and gravel aquifers in these unconsolidated sediments. Natural gamma radiation in glacial and alluvial sediments is directly related to the percentage of clay fraction. Therefore, natural gamma radiation logs are also frequently run in wells and unsuccessful boreholes, in association with electrical earth resistivity surveys, in the search for potable water supplies. Comparisons of the configurations of vertical electrical sounding (VES) curves from surface resistivity surveys and natural-gamma borehole logs from four locations within glacial and alluvial sediments are presented. The Wenner and Schlumberger electrode configurations were employed in acquiring the VES data. Significant correlations were found between the VES curves and downhole log configurations. (See also W87-01641) (Lantz-PTT)
W87-01655

MILITARY REQUIREMENTS FOR GEOPHYSICAL GROUND WATER DETECTION AND EXPLORATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
D. K. Butler, and J. L. Llopis.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 228-248, 13 fig, 3 tab, 9 ref.

Descriptors: *Groundwater availability, *Water requirement, *Groundwater potential, Aquifers, Groundwater quality, White Sands, New Mexico, Electromagnetic waves, Electrical studies, Resistivity, Geophysics, Seismic properties.

Adequate water supply is a critical requirement for support of military operations in arid and semi-arid regions, and for fixed military bases. Groundwater exploration typically will utilize all available information to aid the interpretation of geophysical survey data and produce an integrated assessment for an area. Situations are envisioned, however, in which little or no supplementary information will be available to aid or constrain the interpretation of geophysical survey data. For this latter case, information about groundwater table depth, aquifer thickness, and water quality is required expeditiously at selected, perhaps widely separated, locations. Groundwater detection is a terminology properly applied to rapid groundwater assessments at selected, widely-spaced locations. Case histories are presented illustrating both groundwater exploration and detection. A groundwater detection study at five locations on White Sands Missile Range, New Mexico, illustrates the application of seismic refraction, electrical resistivity, loop-loop low induction number electromagnetic (EM), and transient EM methods. Results of the geophysical methods are compared to known geohydrological conditions. The conclusions of the study can be summarized as follows: Complementary seismic refraction and electrical resistivity surveys (a) can generally be used successfully for groundwater detection when the water table occurs in unconsolidated sediments, and (b) can generally not be used successfully for detection of groundwater in confined rock aquifers. For the case of rock aquifers, a groundwater exploration program is required. The complementary geophysical methodology currently fieldable consists of seismic refraction and electrical resistivity methods. In the near future, the transient electromagnetic method may advantageously replace the electrical resistivity method. (See also W87-01641) (Lantz-PTT)
W87-01656

USE OF GEOPHYSICAL TECHNIQUES IN AN ACCELERATED SEARCH FOR GROUND WATER IN THE CONNECTICUT RIVER VALLEY, MASSACHUSETTS,
Boston Survey Consultants, Inc., MA.
R. W. Heeley, and B. A. Marshall.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 249-264, 5 fig, 5 ref.

Descriptors: *Geophysics, *Geophysical surveys, *Groundwater availability, *Groundwater potential, *Connecticut River, Massachusetts, Whately, Long-term planning, Mill River, Seismic waves, Bedrock, Seismology, Resistivity, Drilling, Aquifer.

Residents of Whately, Massachusetts face a water supply emergency due to the contamination of a shallow phreatic aquifer with ethylene dibromide and aldicarb. A state-funded investigation of emergency, short term, and long term water supply alternatives was initiated. Geophysical techniques were used to locate an artesian aquifer buried beneath glacial lake clays. This aquifer had been developed as a water supply in neighboring communities but not in Whately. Preliminary analyses of well, boring, and outcrop data and previous geophysical studies in surrounding communities indicated that the pre-glacial Mill River had cut a channel into the Triassic bedrock near its present course. Seismic refraction lines of 800 to 2000 feet in length positioned across and along the presumed valley trend were completed using explosives for end, center, and offset shots with linear 800 foot long, 24 geophone arrays. Additional seismic traverses in areas thought to be shallower were conducted with the use of a single channel signal enhancement seismograph and a percussion energy source. A local college also cooperated by investigating some areas with the aid of a 12 channel signal processing seismograph with both reflection and refraction capabilities (See also W87-01641) (Lantz-PTT)
W87-01657

MAGNETIC SURVEY METHODS USED IN THE LUITIAL ASSESSMENT OF A WASTE DISPOSAL SITE,
BCM Engineers, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5B.
W87-01658

APPLICATION OF THE CONTROLLED SOURCE AUDIO MAGNETOTELLURICS (CSAMT) SURVEY TO DELINEATE ZONES OF GROUND WATER CONTAMINATION - A CASE HISTORY,
Engineering Enterprises, Inc., Norman, OK.
T. Syed, K. L. Zonge, S. Figgins, and A. R. Anzzolin.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 282-311, 19 fig, 4 tab, 5 ref. Project No. 68-01-6389.

Descriptors: *Controlled Source Audio Magnetollurics, *Geophysical surveys, *Groundwater pollution, *Case studies, Groundwater quality, Resistivity, Magnetic studies, Geophysics, Aquifers, Electrical studies, Injection wells, Oil fields, Brines, Saline water, plumes.

A surface electrical geophysical technique, Controlled Source Audio-Frequency Magnetotellurics (CSAMT) has been successfully applied to locate the presence of anomalies resulting from the upward movement of formation brines through improperly plugged wells. The primary objective in a CSAMT Survey is to provide apparent resistivity and the phase angle between the electric and magnetic fields over a prospect area. CSAMT has the advantages of excellent lateral resolution, good depth penetration (several thousand feet) and is relatively inexpensive. The frequency and resistivity of the subsurface controls the depth of penetration, so the lower the frequency, the deeper the penetration. The CSAMT technique has been successful in locating low resistivity anomalies resulting from the movement of oilfield brines in the vicinity of improperly plugged wells and near active injection wells. Two deep conductive plumes and one shallow conductive feature were detected and traced in the area of active injection wells in Section 15, while on the grid in Section 16 in the area of improperly plugged wells, one localized deep feature and two deep plumes were detected and traced. Several of these plumes ran out of the edge of the survey grids and their extent is not known. Test drilling and logging results confirmed the low resistivity anomalies detected by the CSAMT Survey. Direct comparisons could not be made among the wells due to variations in the surface resistivities at the different sites. Future studies of this type should gather sufficient data to permit comparison and correlation of known salinity contrasts with resistivity contrasts. Once the baseline contrasts for a given area or oilfield are established, detecting and tracing of conductive plumes might be combined with estimates of water salinity to give even more useful results. (See also W87-01641) (Lantz-PTT)
W87-01659

THEORY & DESIGN CONSIDERATIONS OF A BOREHOLE ELECTROMAGNETIC CONDUCTIVITY PROBE,
Geonics Ltd., Mississauga (Ontario).
F. B. Snelgrove, and J. D. McNeill.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 339-354, 11 fig, 3 ref.

Descriptors: *Borehole geophysics, *Electromagnetic waves, *Conductivity, Measuring instruments, Theoretical analysis, Design standards, Boreholes, Stratification.

This paper describes the theory of electromagnetic induction as it is applied to the design and development of a conductivity measuring, borehole probe. Two particularly critical design factors are considered: first that the probe should be relatively insensitive to the borehole fluid, and second, that it should be able to resolve relatively thin horizontal layers. The borehole fluid can be many times more conductive than the surrounding ground and, if included in the measurement, could completely mask small changes in the geological structure. These two conditions are inversely affected by the intercoil spacing. The equations for the radial and horizontal layer responses are derived as a function of coil spacing and are then used to select the best compromise for the coil separation. Calculations show that a spacing of 0.5 meters appears to give good layer resolution and negligible response to the borehole fluid. The horizontal layer responses are then given in a form which can be used to derive the probe response to any horizontal layered model. Finally, some preliminary borehole test results show that the probe is quite sensitive to small conductivity changes so that thin layers and conductive plumes should be easily identified. (See also W87-01641) (Author's abstract)
W87-01662

DEFINING GLACIAL STRATIGRAPHY WITH THE NEUTRON LOG,
STS Consultants Ltd., Green Bay, WI.
J. A. Senger.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 355-368, 8 fig, 1 ref.

Descriptors: *Stratigraphy, *Logging, *Glaciers, Copper, Zinc, *Borehole geophysics, Glacial drift, Silt, Sand, Gravel, Piezometers, Porosity, Gamma radiation, Water table.

As part of a hydrogeologic study for a proposed underground mine of a copper and zinc sulfide

deposit, selected boreholes (100 to 300 feet deep) in the glacial overburden were geophysically logged, using mechanical, nuclear, and sonic devices. Conventional split spoon sampling was also conducted in the boreholes with sampling intervals ranging from 5 to 60 feet. The glacial deposits consisted of glacial till (silty fine to medium sand and gravel), fine grained outwash (uniformly sorted fine sand), coarse grained outwash (well graded sand and gravel) and glaciolacustrine sediments (varved silt and clay). The purpose of the geophysical logging was to more accurately define the glacial stratigraphy to aid in the selection of piezometer depths and to reduce split spoon sampling. The neutron log was the most useful in making qualitative interpretations in the field. The fine grained outwash generally displayed the highest porosity which can be attributed to the uniform sorting. The glacial till was readily identifiable. The differences between the till and the outwash on the natural gamma and bulk density logs were more subtle. The till generally displayed greater natural gamma radiation and bulk density compared to the outwash. The caliper log was sometimes useful to distinguish between cohesive and noncohesive soils. The neutron log was also very useful in locating the water table. The neutron log showed a large deflection to the left when saturated soils were encountered. However, the results were sometimes misleading of the capillary fringe was not taken into account. The geophysical logging was also helpful in determining whether or not a split spoon sample was representative of the entire stratum. (See also W87-01641) (Author's abstract)
W87-01663

DRY HOLE RESISTIVITY LOGGING,
Converse Consultants, Inc., Las Vegas, NV.
G. P. Lindsey.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 371-376, 2 fig, 1 ref.

Descriptors: *Resistivity, *Logging, *Boreholes, *Measuring instruments, Vadose zone, Soil properties, Monitoring, Electrodes, Groundwater pollution.

This paper describes a device which can be used to log the earth resistivity in a dry-drilled borehole within the vadose zone. The purpose of the logging tool is to measure the soil resistivity at selected depth intervals to determine the presence of contaminant plumes of conductive fluids. The advantages of obtaining in-situ resistivity measurements are: it reduces the need for costly soil sampling and laboratory analysis; allows characterization and calibration of baseline soil conditions for comparison with subsequent resistivity monitoring techniques; and permits the use of drill borings as a viable monitoring method that provides an alternative to methods which require collection of liquids from the unsaturated zone. The device consists of a probe with a fixed spacing Wenner array of four electrodes which expands to make contact with the sides of the borehole and retracts to move up or down the borehole. In evaluating the performance of the probes, the balloon packer type functioned properly but only in medium stiff to stiff soils. Unlike the mechanically operated probe, the rubber inner tube pressure could not be increased or manipulated to affect penetration of the electrodes to make good contact in this type of soil literally caused a blow out. The mechanically operated probe, on the other hand, responded well to slight twisting or up and down manipulation to seat the electrodes so that all depth location were successfully measured for soil resistivity. The data generated by use of the dry hole resistivity logger represents the information which should be a useful tool in many types of applications ranging from monitoring of hazardous waste to routine logging of shallow borings. Its use will give an added dimension to surface resistivity surveys. (See also W87-01641) (Lantz-PTT)
W87-01664

USE OF DOWNHOLE GEOPHYSICAL METHODS IN DETERMINING THE INTERNAL STRUCTURE OF A LARGE LANDFILL,
Warzyn Engineering, Inc., Madison, WI.
R. J. Montgomery, D. A. Wierman, R. W. Taylor, and H. A. Koch.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 377-386, 2 fig, 1 tab.

Descriptors: *Landfills, *Borehole geophysics, *Geophysics, *Soil water, *Subsurface drainage, Sanitary landfills, Wisconsin, Water pollution sources, Stratification, Moisture profiles, Leachates, Logging, Piezometers.

Downhole geophysical methods were utilized to help in determining the internal structure and moisture content distribution of a large sanitary landfill located near Milwaukee, Wisconsin. The 83-acre landfill currently accepts municipal, commercial, and industrial solid waste, though it has also accepted hazardous solids and liquids in the past. The objectives of the geophysical survey were to: (1) determine the number of soil/refuse layers at various points across the landfill, and (2) determine the moisture content profile and the zones of perched liquids within the site. This information is then used in an analysis of potential leachate withdrawal systems. Natural gamma, neutron and density logs were obtained for sixteen cased wells through the landfill, at two-month intervals for a period of four months. In addition, various log calibrations were obtained using landfill clays and refuse. The results indicated that the logging procedure produced a useful description of the landfill cover/refuse content, consistent with independently obtained data. The proposed saturated thickness of refuse was greater than the head levels in piezometers screened at the base of the site. Further attempts were made to quantify porosity and moisture content information using the neutron and density logs. General conclusions regarding construction of wells for geophysical logging in landfills include the following: (1) Construction using rotary or auger drilling methods of the smallest practical diameter will allow greater logging sensitivity to fill section variations; (2) Steel casing pipe must be utilized, in order to resist buckling and breaking caused by continuing landfill consolidation. Two-inch diameter casing is sufficient for borehole logging; and (3) Consolidation of the landfill may create significant irregularities in the fill section or in the casing backfill over time, even if this installation is correct initially. (See also W87-01641) (Lantz-PTT)
W87-01665

BOREHOLE LOGGING TO DELINEATE FRACTURES IN A CONTAMINATED BEDROCK AQUIFER,
NUS Corp., Bedford, MA.
R. J. DeLuca, and B. K. Buckley.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 387-398, 3 fig, 2 ref.

Descriptors: *Borehole geophysics, *Logging, *Geologic fractures, *Aquifers, *Groundwater pollution, Water pollution effects, Path of pollutants, New Hampshire, Wells, Field tests, Resistivity, Gamma radiation.

N U S Corporation, under contract to the US EPA, is currently conducting a Remedial Investigation of a site in Southern New Hampshire, which had been used for the disposal of liquid hazardous waste. Groundwater in overburden and bedrock underlying the site has been impacted by volatile organic contamination. The overburden is not used as a source of groundwater, due to its variable thickness and poor permeability. The fractured metamorphic bedrock, however, supplied potable water to several apartment complexes and numerous local residents. Following the discovery of the contamination of this bedrock aquifer, several 300-foot deep supply wells were abandoned, along with several private bedrock wells. Previous field work at the site included the installation of monitoring wells and performance of a pump test of a former supply well. Results of this work identified a preferred direction of flow through the bedrock under pumping conditions, suggesting a system of linear fractures trending parallel to other regional structural features. The location of these fractures with depth and their lateral extent were not known. In order to prove that contaminants from disposal areas could have impacted the supply wells and residual wells, it was necessary to more fully characterize the bedrock fracture system. Borehole logging has typically been utilized in sedimentary geologic environments. It was felt that these well-established techniques would also have applicability in a metamorphic setting to delineate bedrock fractures which served as pathways for contaminant migration. Four logging functions (caliper, resistivity, SP and natural gamma) were run on eleven bedrock boreholes to determine the vertical distribution of fractures within the boreholes. The caliper and resistivity functions were the most useful in identifying water-filled fractures. The SP function was useful in identifying those water-filled fractures gaining or losing water, which would be the probable pathways for contaminant migration. The natural gamma function, while less useful, provided some information on lithologic changes with depth. It should be noted that there are additional downhole techniques which appear to have merit in this type of investigation. These include acoustic, neutron, temperature and impeller flowmeter logging. (See also W87-01641) (Lantz-PTT)
W87-01666

CONVECTION IN BOREHOLES: LIMITS ON INTERPRETATION OF TEMPERATURE LOGS AND METHODS FOR DETERMINING ANOMALOUS FLUID-FLOW,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W87-01667

RESISTIVITY-POROSITY CROSS PLOTS FOR DETERMINING IN SITU FORMATION WATER QUALITY - CASE EXAMPLES,
Woodward-Clyde Consultants, Tallahassee, FL.
T. Kwader.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 415-424, 3 fig, 2 tab, 6 ref.

Descriptors: *Resistivity, *Geophysical survey, *Borehole geophysics, *Porosity, *Water quality, *Graphical analysis, *Case studies, In situ formation, Saturation, Hydrocarbons, Logging, Geophysical studies, Flow velocity, Water quality control.

Hingle Resistivity-Porosity Cross Plots (RPCP) have been used extensively in the petroleum industry for determining water saturation (S sub w) in formations containing hydrocarbons. Recent studies have shown the RPCP method to be a viable method of estimating formation pore fluid resistivity, (R sub w in ohm-meters). R sub w can be accurately determined by cross plotting saturated resistivity (R sub o), obtained from the induction, normal or lateral resistivity logs against formation bulk porosity from neutron, density or acoustic velocity logs. The graphical cross-plotting technique solves for R sub w based upon the equation R sub w = phi to the m R sub o (m is matrix cementation factor, commonly between 1.4 and 1.8). Once R sub w has been determined various common ion concentrations (particularly chloride, sodium, sulfate and T.D.S.) can be estimated based upon the chemical relationships established from neighboring wells tapping the same type water mass. RPCP's have proven to be a costs effective method for determining vertical changes in water quality in small diameter mud filled test holes. In one instance an irrigation well was effectively plugged back to a depth sufficient to eliminate highly mineralized water. In another case a municipal supply well, located in a coastal area, was successfully drilled deeper in order to increase well yield without compromising water quality. (See also W87-01641) (Author's abstract)
W87-01668

EFFECTS OF WELL-CASING COMPOSITION AND SAMPLING METHOD ON APPARENT QUALITY OF GROUND WATER,
For primary bibliographic entry see Field 8G.
W87-01692

SAMPLING GROUND WATER FOR VOLATILE ORGANIC COMPOUNDS: THE EFFECTS OF SAMPLING METHOD, COMPOUND VOLATILITY AND CONCENTRATION,
For primary bibliographic entry see Field 5A.
W87-01693

PRESERVING THE CHEMICAL INTEGRITY OF A GROUND WATER SAMPLE,
Residuals Management Technology, Inc., Madison, WI.
For primary bibliographic entry see Field 5A.
W87-01694

DETERMINATION OF HYDROCARBON THICKNESSES IN SEDIMENTS USING BOREHOLE DATA,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 5B.
W87-01703

MONITORING PETROLEUM SPILLS WITH WELLS: SOME PROBLEMS AND SOLUTIONS,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 5B.
W87-01704

BIOLOGICAL MONITORING OF MARINE POLLUTANTS.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 5C.
W87-01717

OVERVIEW OF THE ACUTE AND CHRONIC EFFECTS OF FIRST AND SECOND GENERATION PESTICIDES ON AN ESTUARINE MYSID,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W87-01718

EFFECTS OF TWO ORGANOPHOSPHATE PESTICIDES ON SWIMMING STAMINA OF THE MYSID MYSIDOPSIS BAHIA,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W87-01719

APPLICATION OF BIOCHEMICAL AND PHYSIOLOGICAL RESPONSES TO WATER QUALITY MONITORING,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5C.
W87-01728

COMPARISON OF SEVERAL PHYSIOLOGICAL MONITORING TECHNIQUES AS APPLIED TO THE BLUE MUSSEL, MYTILUS EDULIS, ALONG A GRADIENT OF POLLUTANT STRESS IN NARRAGANSETT BAY, RHODE ISLAND,
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 5C.
W87-01731

EFFECTS OF MUNICIPAL WASTEWATER ON FERTILIZATION, SURVIVAL, AND DEVELOPMENT OF THE SEA URCHIN, STRONGYLOCENTROTUS PURPURATUS,
Southern California Coastal Water Research Project Authority, Long Beach.
For primary bibliographic entry see Field 5C.
W87-01733

AVAILABILITY OF AUTOMATIC WATER QUALITY MONITORING FOR FINNISH WATERCOURSES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Kohonen.
National Board of Waters, Finland. Water Research Institute Publication No. 62, 1985. p3-19, 73 ref.

Descriptors: *Monitoring, *Instrumentation, *Water quality control, *Automatic control, *Finland, Water temperature, Hydrogen ion concentration, conductivity, Dissolved oxygen, Turbidity, Chlorides, Pulp and paper industry, Municipal wastewater, Streams.

The Finnish National Board of Waters has used during the years 1974-1983 eleven automatic water quality monitoring stations, of which five made up the River Kymijoki and Kokemaenjoki system and the others were easily transportable stations. The variables measured were temperature, pH, conductivity, dissolved oxygen and turbidity, as well as chloride at five stations. The major problems were difficulties in sample water pumping and malfunctions of the station microprocessors and the system main computer. The operational efficiencies of both the stations and the measured variables were satisfactory and improved markedly when maintenance procedures were modified from troubleshooting calls to preventive maintenance. Automatic monitoring disclosed at many locations previously undetected fluctuations in water quality, while at other points confirming the stability of the quality level. Continuous monitoring revealed illicit discharges by the pulp and paper industry and displayed the effects of unusual operations on water quality. The effects of treated municipal waste waters on stream quality could also be clearly observed, especially during the summer season. Stream regulation and dredging altered noticeably and rapidly the quality of the water. The character of fluctuations in water quality, the statistical parameters of the data and the optimal monitoring frequencies calculated from these values can be applied to the development of manual monitoring. There are only a few watercourses in Finland requiring permanent automatic water quality monitoring stations. Mobile automatic stations are suitable for the water quality monitoring of small streams over a relatively short time. The automatic monitoring of water quality of watercourses should be used as a part of a wider joint supervision of the environment. (Author's abstract)
W87-01739

SCPP METEOROLOGICAL AND STATISTICAL SUPPORT FOR PERIOD 1 SEPTEMBER 1984 - 31 AUGUST 1985, VOLUME II: (EXPERIMENTAL DAY SUMMARIES) INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
G. L. Hemmer, A. W Huggins, A. P. Kuciauskas, and C. J. Wilcox.
Available from the National Technical Information Service, Springfield, VA. 22161. as PB86-189412, A10 in paper copy, A01 in microfiche. October 1985. 200 p, 150 fig, 3 tab. Contract No. 4-CR-81-03860.

Descriptors: *Forecasting, *Remote sensing, *Sierra Cooperative Pilot Project, *Statistical analysis, *Cloud seeding, Radar, Rawinsonde, Carbon dioxide, Satellite technology, Model studies, Wind, Ice, Sierra Nevada Mountains, Weather modification, Clouds.

Field operations and data collection procedures for the SCPP forecast office, radar and rawinsondes are described and analyzed. Seeding effects in radar data are described for convective clouds seeded with CO2 and AgI. The passage of certain radar echoes was found to be associated with lowering cloud top and an increase in supercooled liquid water (SLW) at Kingvale. In conjunction with satellite data such correspondence may be used to help predict the occurrence of clouds suitable for seeding experiments. One detailed case study revealed a situation where SLW was plentiful in a region upwind of the crest, but was negligible near the crest because of depletion by secondary ice crystal production. Efforts aimed at upgrading the GUIDE model are discussed. Comparisons are made among model versions and between model winds and measured winds. A technique using data from three rawinsondes was found to give the most reliable targeting information for fixed target seeding experiments. Radiometer and rawinsonde parameter comparisons gave generally poor correlations. Some aggregate studies of microphysical data showed treatment effects in both categories of floating target clouds. The randomization techniques of both floating target and fixed target experiments are described. (Lantz-PTT)
W87-01763

7C. Evaluation, Processing and Publication

HISTORICAL STREAMFLOW SUMMARY: ALBERTA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
Available from Environment Canada, Bag 2909, Postal Station 'M', Calgary, Alberta. T2P 2M7. 527 p.

Descriptors: *Streamflow, *History, *Alberta, Canada, Hydrologic data collections, Data collections, Data acquisition.

Surface Water Data have been published in a variety of formats in imperial units since 1908 in approximately 300 publications which are now mostly out-of-print. Commencing with the 1979 publications, data are presented in the International System of Units (SI). However, the format has remained the same wherein Canada is divided into eight regions. The provinces each represent a separate region except for New Brunswick, Newfoundland, Nova Scotia and Prince Edward Island which together form the Atlantic Provinces region, and the Yukon and Northwest Territories which make up another. The publications are identified by the province(s) or territories covered and the year in which data were collected. These data are published annually on a calendar-year basis and the stations are listed alphabetically, with two years of data per page. Hydrometric surveys in Alberta were conducted by the Water Survey of Canada under agreement with the Province of Alberta. The provincial authorities contributed in the costs of the basic field investigations which were carried out in accordance with mutually agreed-upon plans. Descriptive information about a gauging station is given here, below the table of monthly and annual mean discharges. This refers to such items as latitude and longitude, drainage area and whether the flow is natural or regulated (the year that regulation began is given, if known); International Gauging Stations are identified and the names of co-operating agencies who supply data are given; unusual conditions are explained under 'Remarks'. The overall accuracy or the degree of reliability of hydrometric data referred to here, depends upon: (1) The type of gauge, stability of gauge, accuracy of observation of stage and measurement of reference datum; (2) The stability of the stage-discharge relationship, or if the control is unstable, the frequency and accuracy of discharge measurements; and, (3) The computation procedures and interpretation of records. Because of all these variable factors, the number of significant figures used have been standardized for uniformity of presentation and does not reflect the degree of accuracy of the data. The Water Resources Branch standard for storing water level data is to three decimal points (0.001 m), although some contributing agencies provide data to two decimal points (0.01 m). A measure of the reliability of the records can be made by an examination of the distribution of the symbols A, E and B (for discharge data). In general, data collected during open-water periods are more reliable than those collected during periods of ice conditions or those obtained by estimation. Further, water level data collected utilizing a water-stage recorder are more reliable and accurate than those using a manual gauge only, especially for small or flashy streams. (Lantz-PTT)
W87-00873

HISTORICAL STREAMFLOW SUMMARY: BRITISH COLUMBIA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
Available from Environment Canada, Bag 2909, Postal Station 'M', Calgary, Alberta. T2P 2M7. 527 p.

Descriptors: *Streamflow, *History, *British Columbia, *Canada, Hydrologic data collections, Data collections, Data acquisition.

Surface Water Data have been published in a variety of formats in imperial units since 1908 in approximately 300 publications which are now mostly out-of-print. Commencing with the 1979 publications, data are presented in the International System of Units (SI). However, the format has remained the same wherein Canada is divided into eight regions. The provinces each represent a separate region except for New Brunswick, Newfoundland, Nova Scotia and Prince Edward Island which together form the Atlantic Provinces region, and the Yukon and Northwest Territories which make up another. The publications are identified by the province(s) or territories covered and the year in which data were collected. These data are published annually on a calendar-year basis and the stations are listed alphabetically, with two years of data per page. Hydrometric surveys in British Columbia were conducted by the Water Survey of Canada under agreement with the Province. The provincial authorities contributed in the costs of the basic field investigations which were carried out in accordance with mutually agreed-upon plans. Descriptive information about a gauging station is given here, below the table of monthly and annual mean discharges. This refers to such items as latitude and longitude, drainage area and whether the flow is natural or regulated (the year that regulation began is given, if known); International Gauging Stations are identified and the names of co-operating agencies who supply data are given; unusual conditions are explained under 'Remarks'. The overall accuracy or the degree of reliability of hydrometric data referred to here, depends upon: (1) The type of gauge, stability of gauge, accuracy of observation of stage and measurement of reference datum; (2) The stability of the stage-discharge relationship, or if the control is unstable, the frequency and accuracy of discharge measurements; and, (3) The computation procedures and interpretation of records. Because of all these variable factors, the number of significant figures used have been standardized for uniformity of presentation and does not reflect the degree of accuracy of the data. The Water Resources Branch standard for storing water level data is to three decimal points (0.001 m), although some contributing agencies provide data to two decimal points (0.01 m). A measure of the reliability of the records can be made by an examination of the distribution of the symbols A, E and B (for discharge data). In general, data collected during open-water periods are more reliable than those collected during periods of ice conditions or those obtained by estimation. Further, water level data collected utilizing a water-stage recorder are more reliable and accurate than those using a manual gauge only, especially for small or flashy streams. (Lantz-PTT)
W87-00883

CHARACTERISTICS OF BENCH-MARK STREAMS.
For primary bibliographic entry see Field 5B.
W87-00977

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOME LAKES IN NORTH AMERICA FOR WHICH SEDIMENT-DIATOM DATA EXIST.
For primary bibliographic entry see Field 5B.
W87-00978

HISTORICAL STREAMFLOW SUMMARY: MANITOBA, 1984.
Inland Waters Directorate, Ottawa (Ontario).
Available from Environment Canada, Bag 2909, Postal Station 'M', Calgary, Alberta. T2P 2M7. 527 p.

Descriptors: *Streamflow, *History, *Manitoba, Canada, Hydrologic data collections, Data collections, Data acquisition.

Surface Water Data have been published in a variety of formats in imperial units since 1908 in approximately 300 publications which are now mostly out-of-print. Commencing with the 1979 publications, data are presented in the International System of Units (SI). However, the format has remained the same wherein Canada is divided into eight regions. The provinces each represent a separate region except for New Brunswick, Newfoundland, Nova Scotia and Prince Edward Island which together form the Atlantic Provinces region, and the Yukon and Northwest Territories which make up another. The publications are identified by the province(s) or territories covered and the year in which data were collected. These data are published annually on a calendar-year basis and the stations are listed alphabetically, with two years of data per page. Hydrometric surveys in Manitoba were conducted by the Water Survey of Canada under agreement with the Province of Manitoba. The provincial authorities contributed in the costs of the basic field investigations which were carried out in accordance with mutually agreed-upon plans. Descriptive information about a gauging station is given here, below the table of monthly and annual mean discharges. This refers to such items as latitude and longitude, drainage area and whether the flow is natural or regulated (the year that regulation began is given, if known); International Gauging Stations are identified and the names of co-operating agencies who supply data are given; unusual conditions are explained under 'Remarks'. The overall accuracy or the degree of reliability of hydrometric data referred to here, depends upon: (1) The type of gauge, stability of gauge, accuracy of observation of stage and measurement of reference datum; (2) The stability of the stage-discharge relationship, or if the control is unstable, the frequency and accuracy of discharge measurements; and, (3) The computation procedures and interpretation of records. Because of all these variable factors, the number of significant figures used have been standardized for uniformity of presentation and does not reflect the degree of accuracy of the data. The Water Resources Branch standard for storing water level data is to three decimal points (0.001 m), although some contributing agencies provide data to two decimal points (0.01 m). A measure of the reliability of the records can be made by an examination of the distribution of the symbols A, E and B (for discharge data). In general, data collected during open-water periods are more reliable than those collected during periods of ice conditions or those obtained by estimation. Further, water level data collected utilizing a water-stage recorder are more reliable and accurate than those using a manual gauge only, especially for small or flashy streams. (Lantz-PTT)
W87-00981

ESTIMATED NUMBERS OF BACTERIA IN SAMPLES FROM NON-HOMOGENEOUS BODIES OF WATER: HOW SHOULD MPN AND MEMBRANE FILTRATION RESULTS BE REPORTED,
Central Public Health Lab., London (England). Communicable Disease Surveillance Centre.
For primary bibliographic entry see Field 5A.
W87-01007

APPLYING LOGIC PROGRAMMING IN HYDROLOGY. DEFINITION OF A PROGRAM FOR THE AUTOMATIC INTERPRETATION OF PUMPING TEST DATA,
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
C. Certes, and P. Hubert.
Journal of Hydrology JHYDA7, Vol. 81, No. 1/2, p 137-155, October 30, 1985. 7 fig, 19 ref.

Descriptors: *Groundwater movement, *Pumping tests, *Data storage and retrieval, *Computer programs, *PROLOG, Data processing, Drawdown.

Hydrological research almost always involves computers for stocking, retrieving, and analyzing hydrological data. These data, mostly numerical, will not be the only kind to be dealt with in the future. In the field of artificial intelligence, engineers have mastered the ability of manipulating objects (strings of characters, lists, etc.) as well as numbers. For example, expert systems reproduce the remarks and answers an expert would give to a problem, following logical reasoning (given the rules governing the problem environment). This paper presents this new way of programming and introduces the reader to a problem-oriented language, PROLOG (programming in logic), illustrated by an example. It also relates the drafting of a selector of interpretation methods of pumping test data in the form of a small expert system written in PROLOG. The resemblance of form between the drawdown test curve and each theoretical method curve is used to select the best interpretation methods. (Doria-PTT)
W87-01176

ENTROPY AS A MEASURE OF HYDROLOGIC DATA UNCERTAINTY AND MODEL PERFORMANCE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
T. G. Chapman.
Journal of Hydrology JHYDA7, Vol. 85, No. 1/2, p 111-126, June 15, 1986. 6 fig, 3 tab, 12 ref.

Descriptors: *Entropy, *Hydrologic models, *Model studies, *Model testing, *Hydrologic data, Mathematical studies, Thermodynamics, Hydrology.

The original use of entropy by Amorocho and Espildora is extended as a measure of uncertainty in hydrologic data and the reduction in that uncertainty due to application of a model. In many situations, calculations of entropy ought to be based on a proportional rather than a fixed class interval. General equations are given for the proportional class interval, are solved for assumed lognormal and gamma distributions, and are extended to data series with zero values. The solutions are shown to be independent of the units of measurement of the original data. Results are applied to the comparative evaluation hydrologic models using the same and different data sets, and a new criterion of model performance is suggested for the latter case. (Author's abstract)
W87-01183

IMPROVED METHOD OF LEAST-SQUARES PARAMETER ESTIMATION WITH PUMPING-TEST DATA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W87-01190

RUPTURES AND SERIOUS ACCIDENTS ON DAMS FROM 1964 TO 1983, (LES RUPTURES ET ACCIDENTS GRAVES DE BARRAGES DE 1964 A 1983),
For primary bibliographic entry see Field 8A.
W87-01330

DISJUNCTIVE KRIGING 3. COKRIGING,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 2G.
W87-01586

PERIODIC GAMMA AUTOREGRESSIVE PROCESSES FOR OPERATIONAL HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-01588

STRATEGY FOR THE HYDROLOGIC INTERPRETATION OF WELL LOGS,
Nevada Univ. System, Reno. Water Resources Center.

K. C. Taylor, S. W. Wheatcraft, and L. G. McMillion.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 314-323, 2 fig, 6 ref.

Descriptors: *Hydrologic properties, *Borehole geophysics, *Well logs, *Data interpretation, Geophysics, Porosity, Hydraulic conductivity, Gamma radiation, Cation exchange, Groundwater movement, Flowmeters, Flow velocity.

The use of borehole geophysics in hydrologic investigations requires a strategy to make the transition from the measured geophysical parameters to the information needed by the hydrologist. This strategy utilizes a test hole to determine site specific relationships for porosity and hydraulic conductivity, natural gamma emissions and cation exchange capacity, and a porosity vs. natural gamma lithology crossplot. Darcy's Law, the Waxman/Smits shaley sand electrical conductivity model, and a density/porosity model are used to combine this information with density, natural gamma and electrical conductivity logs. This procedure makes it possible to obtain the following logs: porosity, hydraulic conductivity, groundwater velocity, lithology, cation exchange capacity and pore fluid conductivity. If a thermal horizontal flow meter is included in the logging suite, an indication of anisotropy can be obtained by comparing its velocity measurement, which is made at a point, to the velocity measurement from the logs, which is based on the gradient of the regional piezometric surface. The use of this practical strategy allows the hydrologist to deal with the complex situations frequently encountered. (See also W87-01641) (Author's abstract)
W87-01660

STRATIGRAPHIC DETERMINATIONS AND CORRELATIONS BASED ON BOREHOLE GEOPHYSICS,
Florida Geological Survey, Tallahassee.
S. M. Spencer.
IN: NWWA Conference on Surface and Borehole Geophysical Methods in Ground Water Investigations, February 12-14, 1985, Fort Worth, Texas. 1985. p 326-338, 7 fig, 4 ref.

Descriptors: *Stratigraphy, *Borehole geophysics, *Data interpretation, Florida, Aquifers, Sediments, Geologic history, Subsurface mapping, Cores, Geophysical logging, Gamma radiation, Carbonates, Sand, Clays.

Formational units in north Florida can be distinguished using borehole geophysical parameters. The shallow subsurface units are comprised of surficial sediments; a middle confining unit, the phosphatic Hawthorn Formation; and the Floridan Aquifer comprised of Eocene and Oligocene limestones. Borehole geophysical logs which were run by two Florida water management districts and the Florida Geological Survey were selected for this study. Core data from these locations or nearby sites contributed correlative lithologic control. Geophysical logs were selected in the area extending from the Gulf Trough in Gadsden County, Florida, eastward to St. Johns County, Florida, near the Atlantic Coast. Correlations from the geophysical logs used in this study were based primarily on natural gamma with electric, neutron, and density logs used whenever available as secondary qualitative sources. In the Gulf Trough, clastic and carbonate strata are mixed resulting in a blurring of the geophysical signatures in the shallow subsurface. East of the trough, sediments of the Hawthorn Formation are clearly discerned and are traceable across north Florida. The Hawthorn Formation sediments, which are comprised of sands, clays, and carbonates, make up the main aquiclude that separates the overlying sediments from the underlying Floridan Aquifer. The Hawthorn Formation is distinguished by the high natural gamma signatures in contrast to the underlying limestone aquifer which has low activity signatures. The use of borehole geophysical parameters lends itself well to determining thickness and areal extent of stratigraphic units in north Florida. (See also W87-01641) (Author's abstract)
W87-01661

DISCRIMINATION BETWEEN REAL AND APPARENT ACCUMULATION OF IMMISCIBLE HYDROCARBONS ON THE WATER TABLE: A THEORETICAL AND EMPIRICAL ANALYSIS,
Oil Recovery Systems, Inc., Needham, MA. Groundwater Technology Div.
For primary bibliographic entry see Field 5B.
W87-01705

HISTORICAL STREAMFLOW SUMMARY: SASKATCHEWAN, 1984.
Inland Waters Directorate, Ottawa (Ontario).
Available from Environment Canada, Bag 2909, Postal Station 'M', Calgary, Alberta. T2P 2M7. 527 p.

Descriptors: *Streamflow, *History, *Saskatchewan, Canada, Hydrologic data collections, Data collections, Data acquisition.

Surface Water Data have been published in a variety of formats in imperial units since 1908 in approximately 300 publications which are now mostly out-of-print. Commencing with the 1979 publications, data are presented in the International System of Units (SI). However, the format has remained the same wherein Canada is divided into eight regions. The provinces each represent a separate region except for New Brunswick, Newfoundland, Nova Scotia and Prince Edward Island which together form the Atlantic Provinces region, and the Yukon and Northwest Territories which make up another. The publications are identified by the province(s) or territories covered and the year in which data were collected. These data are published annually on a calendar-year basis and the stations are listed alphabetically, with two years of data per page. Hydrometric surveys in Saskatchewan were conducted by the Water Survey of Canada under agreement with the Province of Saskatchewan. The provincial authorities contributed in the costs of the basic field investigations which were carried out in accordance with mutually agreed-upon plans. Descriptive information about a gauging station is given here, below the table of monthly and annual mean discharges. This refers to such items as latitude and longitude, drainage area and whether the flow is natural or regulated (the year that regulation began is given, if known); International Gauging Stations are identified and the names of co-operating agencies who supply data are given; unusual conditions are explained under 'Remarks'. The overall accuracy or the degree of reliability of hydrometric data referred to here, depends upon: (1) The type of gauge, stability of gauge, accuracy of observation of stage and measurement of reference datum; (2) The stability of the stage-discharge relationship, or if the control is unstable, the frequency and accuracy of discharge measurements; and, (3) The computation procedures and interpretation of records. Because of all these variable factors, the number of significant figures used have been standardized for uniformity of presentation and does not reflect the degree of accuracy of the data. The Water Resources Branch standard for storing water level data is to three decimal points (0.001 m), although some contributing agencies provide data to two decimal points (0.01 m). A measure of the reliability of the records can be made by an examination of the distribution of the symbols A, E and B (for discharge data). In general, data collected during open-water periods are more reliable than those collected during periods of ice conditions or those obtained by estimation. Further, water level data collected utilizing a water-stage recorder are more reliable and accurate than those using a manual gauge only, especially for small or flashy streams. (Lantz-PTT)
W87-01767

8. ENGINEERING WORKS

8A. Structures

NEW APPROACHES TO REHABBING OLD DAMS,
N. Parrett.
Civil Engineering, Vol. 56, No. 6, p 74-76, June 1986.

Descriptors: *Bureau of Reclamation, *Dam construction, *Dam rehabilitation, Montana, New Mexico, Colorado, South Dakota, Spillways, Retaining walls, Flexible membranes, Fuse plugs, Auxiliary spillways.

The efforts of the Bureau of Reclamation to employ innovative approaches in rehabilitation of old dams are described. At Gibson Dam, on the Sun River 70 mile west of Great Falls, Montana, the top of the dam was rebuilt to allow overtopping to a flood height of 12 ft. A labyrinth spillway was installed at Ute Dam near Logan, New Mexico; its zig-zag configuration increased the effective spillway length within the given length of the dam crest. The earthfill Lake Sherburne Dam in Montana was raised to increase storage capacity by means of patented Reinforced Earth retaining walls, which cut construction time to one 5-month season rather than two. At Pactola Dam, near Rapid City, South Dakota, the dam embankment is being raised 15 ft and the spillway widened from 350 to 435 ft. Flexible membranes were used last year to replace the aging spillway on Cottonwood Dam No. 5, near Grand Junction, Colorado. Research has been conducted on use of auxiliary spillways with fuse plugs, but to date no auxiliary spillways with fuse plugs have been built. (Rochester-PTT)
W87-01046

TUNNEL THAT CLEANED UP CHICAGO,
For primary bibliographic entry see Field 5D.
W87-01048

WATERWAY IS PUBLIC WORKS LANDMARK,
K. A. Godfrey, Jr.
Civil Engineering, Vol. 56, No. 7, p 42-45, July 1986. 4 fig.

Descriptors: *Canals, *Tennessee-Tombigbee Waterway, *Design, *Construction, *Cost analysis, *Dam construction, Environmental effects, Slurry trench, Locks, Economics, Politics.

The Tennessee-Tombigbee Waterway, a nearly 2 billion dollar, 234-mile long barge canal in the southeast, is the Corps of Engineers' costliest, most criticized, and environmentally most-studied project ever. Aspects of design and construction discussed here are the Divide Cut excavation, excavation and filling at lock and dam sites using the slurry-trench method, employment of cutoff walls, and bathtub section locks. Environmental protection activities included creation of buffer strips, relocating of critical parts of the canal, and excavation of archeological sites. Although nearly cancelled during the Carter Presidency, the 'Tenn-Tom' project was saved by political pressure from local Congressional representatives. The project's cost increased by a factor of six times the original estimate between 1972 and 1984, partly due to an increase by three and one-half times in the price of diesel fuel. (Rochester-PTT)
W87-01049

RCC DAM RISING 'LIKE A WEED' FOR N.J. WATER,
W. G. Reinhardt.
Engineering News Record, Vol. 216, No. 25, p 58, June 19, 1986.

Descriptors: *New Jersey, *Dams, *Concrete dams, *Dam construction, Construction.

Placement of roller-compacted concrete (RCC) at Monksville Dam in northern New Jersey is running around the clock at rates of up to 8,000 cu yd per day. Half of the RCC has been placed, and the 317,000 cu yd dam should be completed by late July 1986. Jump forms are used to place the face in specially designed steps just ahead of each new RCC lift. Coil rods are used in alternating lifts to tie the face and RCC together. To prevent seep-

age, a strip of plastic that swells to eight times its volume when exposed to water is placed a few feet behind the point where the coil rods are anchored to the RCC. For lifts not tied into the face, a six-foot-wide layer of bedding mix is spread to ensure a watertight bond. (Doria-PTT)
W87-01157

ROLLCRETE DAM DESIGN EVOLUTION,
For primary bibliographic entry see Field 8F.
W87-01159

MATHEMATICAL MODELLING OF YACYR-ETA-APIPE SCHEME ON THE RIO PARANA,
Lahmeyer International G.m.b.H., Frankfurt-am-Main (Germany, F.R.).
For primary bibliographic entry see Field 4A.
W87-01329

RUPTURES AND SERIOUS ACCIDENTS ON DAMS FROM 1964 TO 1983, (LES RUPTURES ET ACCIDENTS GRAVES DE BARRAGES DE 1964 A 1983),
A. Lebreton.
La Houille Blanche, No. 6/7, p 529-544, 1985. 15 tab, 13 ref, 2 append.

Descriptors: *Dams, *Accidents, *Data collections, *Risks, *Dam failures, Mathematical studies.

An almost complete list of ruptures of major dams (height at least 15 m above the foundations) for a twenty year period, and a partial list for smaller dams as well, based on an extensive search of the literature is presented. These accidents are analyzed: frequency, causes, geographic distribution and distribution according to age and type of dam. Finally, the consequences of these accidents are examined and the risk to populations resulting from dam failures is estimated. (Airone-PTT)
W87-01330

THERMAL CRACKING IN CONCRETE OF THE SAYANO-SHUSHENSKOE DAM,
For primary bibliographic entry see Field 8F.
W87-01350

ON-SITE MARKING OF THE AXES OF THE STRUCTURES OF THE SHUL'BINSK HYDROELECTRIC STATION,
B. O. Orynbaev, and N. G. Bersenev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 5-8, July 1985. 1 fig, 1 ref. Translated from Gidrotekhnische Stroitel'stro, No. 1, January 1985.

Descriptors: *Structural engineering, *Hydraulic structures, *Hydroelectric plants, *Hydraulic fill dams, Powerplants, Mathematical studies, Construction, Dam construction, Engineering, USSR.

On-site marking and fixing of the axes of hydraulic structures requires a considerable amount of precision geodetic work. The axes of the structures of the Shul'binsk hydroelectric station were marked using equations of center lines composed on the basis of the design coordinates. For marking the axes at the construction site, second-order hydrotechnical triangulation was created in the form of a central system of seven points. The network is based on two base lines located on the right and left banks of the river measured by Invar wires. To eliminate centering and reduction errors, designs of station marks with induced centering wire were used. Angular measurements were made with an OT-2M theodolite with 12 complete rounds. The error of closure in the triangles was less than 1.8 seconds of arc. The rms error of the angle as a result of the equation was 0.73 seconds of arc. The relative error of the weakest side of the network was 1:253,000. The network meets the requirements imposed on second-order hydrotechnical triangulation. (Doria-PTT)
W87-01351

WATER-MANAGEMENT AND POWER USE OF THE ARAKS RIVER,
Z. A. Bagirov, and S. E. Bravarnik.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 35-40, July 1985. 5 fig, 2 tab. Translated from Gidrotekhnische Stroitel'stro, No. 1, January 1985.

Descriptors: *Water management, *Electric power production, *Hydraulic structures, Resources management, Reservoirs, Dams, River flow, Araks River, Runoff, USSR.

The 'Araks' hydro development made it possible to construct a reservoir with a useful storage capacity of 1.1 billion cu m. The 41-meter high earth dam has a central clay core and shoulders of rubbly soil. The dam core penetrates the channel pebble deposits. A grout curtain was made under the cutoff in the dam foundation. The slopes of the dam are revetted; the upstream by reinforced-concrete slabs, and the downstream by sodding in stone cells. The annual increase of water resources of the Araks River (1.1 billion cu m) has answered much of the demands of irrigation and fisheries, while the hydroelectric stations generate an average of 160 million kW-hr of electricity per year. However, the 'Araks' development only partly regulates the river runoff, and other regulating reservoirs and hydrostations will need to be constructed by 1990. (Doria-PTT)
W87-01356

EVALUATION OF THE RELIABILITY OF HYDRAULIC STRUCTURES,
V. M. Lyatkher, L. A. Zolotov, I. N. Ivashchenko, and V. B. Yancher.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 2, p 45-55, August 1985. 9 fig, 5 tab, 12 ref. Translated from Gidrotekhnische Stroitel'stro, No. 2, February 1985.

Descriptors: *Evaluation, *Hydraulic structures, *Structural engineering, *Stability analysis, Engineering, Materials engineering, Construction, Mathematical studies.

Failures of hydroelectric structures occur despite the effort to reduce to zero the probability of their occurrence. The variability of external effects and parameters of hydraulic structures govern the use of methods of reliability theory for finding optimal solutions for the design, construction, and operation of these structures. Complete realization of the methods of reliability theory is not always possible due to their insufficient development and the lack of data on the statistical characters of the load and properties of materials. It is advisable at first to use simpler methods such as the regulated value of the permissible probability of failures or damage during the year based on the generalized operating experience of various types of hydraulic structures. It is suggested that the permissible annual probability of failure be less than 0.00001-0.0001. (Doria-PTT)
W87-01357

RESULTS OF ON-SITE OBSERVATIONS OF THE STATE OF STRUCTURES AT THE KANEV HYDROELECTRIC STATION,
S. I. Karlin, and V. A. Shul'ga.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 2, p 89-95, August 1985. 5 fig, 4 ref. Translated from Gidrotekhnische Stroitel'stro, No. 2, February 1985.

Descriptors: *Hydraulic structures, *Hydraulic equipment, *Hydroelectric plants, *Monitoring, Powerplants, Safety, Stress, Seepage, USSR.

The measuring and monitoring equipment installed at the Kanev hydrostation permit systematic monitoring of the state and behavior of the main structures; the organization of on-site observations was performed successfully and is recommended for use at other facilities. Observations confirmed the integrity of the structures during construction and operation. Safety and reliability of structures are provided by reliable designs and high-quality construction, and by close engineering supervision, including constant observations of the structures with observance of the technical operating regulations. (Doria-PTT)
W87-01361

PREPARATION OF THE STRUCTURE OF THE HOA-BINH HYDRO DEVELOPMENT FOR PASSAGE OF THE FLOOD,
P. G. Bogachenko, B. I. Godunov, and G. N. Tsedrov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 2, p 96-101, August 1985. 6 fig, 3 ref. Translated from Gidrotekhnische Stroitel'stro, No. 2, February 1985.

Descriptors: *Dams, *Hydraulic structures, *Hydraulics, *Floodproofing, *Hoa-Binh hydro development, Diversion channels, Dam design, Dam construction, Flood protection, Structural engineering, Engineering, Vietnam.

After damming the Da River (Vietnam) on January 12, 1983, it was necessary to perform model hydraulic investigations to validate the provisions made for safe passage of the flood through the diversion canals. Structural elements and special design features of the dam are described. The investigations made it possible to predict complex and dangerous hydraulic conditions for these structures and to develop timely measures to protect them from the effect of the flow under conditions of a discharge of rare frequency. (Doria-PTT)
W87-01362

MAIN ENGINEERING-GEOLOGICAL PROBLEMS OF CONSTRUCTING THE HOA-BINH HYDRO DEVELOPMENT ON THE DA RIVER (VIETNAM),
L. A. Molokov, S. I. Skiba, and E. Z. Dobrin.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 2, p 101-107, August 1985. 2 fig, 6 ref. Translated from Gidrotekhnische Stroitel'stro, No. 2, February 1985.

Descriptors: *Hoa-Binh hydro development, *Engineering geology, *Vietnam, *Engineering, *Geology, *Construction, Dams, Reservoirs, Hydraulic structures, Hydroelectric plants, Powerplants.

The construction of the Hoa-Binh hydro development is being accomplished under the following very complex engineering-geological conditions: complexity of the structural and tectonic conditions of the entire region; complex secondary alterations of the composition and properties of the bedrock masses under the effect of hydrothermal fluids; wide and intensive development of a karst on the divide between the Da and Ma Rivers within the basin of the reservoir and part of the dam barrier; presence of a thick (to 60 m) stratum of very permeable alluvium in the base of the dam; diversity of the composition and properties of volcanites composing the stretch of the main structures and being used for rock fill; markedly nonuniform and intense bedrock weathering processes; diversity of the modes of occurrence, composition, and the properties of the eluvial, deluvial, and alluvial cohesive soils being used for the dam core. (Doria-PTT)
W87-01363

SHAMKHOR HYDRO DEVELOPMENT,
E. V. Aliev, R. A. Gamidov, P. A. Polstyanov, and A. G. Seidov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 109-117, September 1985. 6 fig, 1 tab. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Shamkhor hydro development, *Hydroelectric plants, *Hydraulic structures, *Inselber, *Construction, *Engineering, Geology, Powerplants, Reclamation, Water resources development, Electric power production, Reservoirs, Earth dams, Dams, USSR.

A river valley with an inselberg structure was selected as the site of the Shamkhor hydro development. The inselberg (a residual upland located in the middle of the valley) is used as the connecting link in the unified barrier for joining the channel and floodplain dams, considerably reducing the volume of earthworks and construction time. Placement of soils from useful cuts in the dams markedly reduced soil transportation costs, and the

location of borrow pits in the flowage lands reduced the areas of farmlands lost to construction. The selected variant of the location, layout, and design of an individual irrigation intake instead of the original variant combined with the intake of the hydrostation provides continuous delivery of water for irrigation and domestic drinking water supply in a wide range of reservoir water levels with a considerable reduction of investments in the irrigation structures of the hydro development. The implemented variant of diverting the Shamkhorchai River into the upper pool of the hydro development instead of the original variant of diversion into the lower pool provided an additional runoff into the reservoir and generation of additional electricity, eliminated the need to construct structures for diverting the Shamkhorchai River into the lower pool, and reduced the construction cost. (Doria-PTT)
W87-01364

ENGINEERING-GEOLOGICAL CONDITIONS OF CONSTRUCTION OF THE SHAMKHOR HYDRO DEVELOPMENT ON THE KURA RIVER,
B. V. Malyutkin, and L. A. Molokov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 118-124, September 1985. 2 fig, 2 tab. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Engineering, *Geology, *Construction, *Engineering geology, *Shamkhor hydro development, USSR, Geomorphology, Hydraulic structures.

The assessment of the engineering-geological conditions for construction of the Shamkhor hydro development on the Kura River proved to be reliable, and the slight refinements during documentation of the pits did not lead to a fundamental revision of design. Differences between the actual geological structure and the geological prediction were confined to the junctions of geomorphological elements (between the ancient floodplain and inselberg, and between the left-bank projection and the modern floodplain and channel). Therefore, it is recommended to explore such stretches with a denser network of workings. The detected presence of an ancient overdeepened channel filled with a thick stratum of gravel-pebble sediments, neotectonic activity, marked difference in the water content of the rocks on the left and right banks, low natural water content, and high degree of slump-proneness of the left-bank loamy sand-loam cover are characteristic for the entire middle Kura valley and should be taken into account when making design decisions at the earliest stages of surveys. (Doria-PTT)
W87-01365

HYDROPOWER ENGINEERING OF THE NORTHERN CAUCASUS,
B. N. Fel'dman.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 124-129, September 1985. 3 fig, 2 tab, 2 ref. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Engineering, *Caucasus, *Hydroelectric power, *Energy sources, *Site selection, Electric power production, Water resources development, Hydraulic structures, Economic aspects, USSR.

An examination of the prospects of hydropower construction in the Northern Caucasus showed that the development of the unused part of the economic hydropotential will make it possible to save about 4 million tons of reference fuel, solving many extremely important problems of the multipurpose use of water resources and development of industrial facilities and infrastructure and a number of social problems in the mountainous regions of republics of the Northern Caucasus. When planning various water-management installations in the Northern Caucasus, it is necessary to examine the economic expediency of using the drops of the water levels created on the hydraulic structures for including small hydrostations as part of these structures. (Doria-PTT)
W87-01366

STRESS-STRAIN STATE OF UNSEALED GRAVITY DAMS,
For primary bibliographic entry see Field 8F.
W87-01367

EXPERIENCE IN THE UNIFICATION OF STRUCTURES OF PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8C.
W87-01374

DESIGN OF PENSTOCKS OF PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8C.
W87-01375

INTAKE OF THE ZAGORSK AND KAISIADORYS PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8C.
W87-01376

EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF THE KAISIADORYS PUMPED-STORAGE STATION,
For primary bibliographic entry see Field 8C.
W87-01378

STATIC CALCULATION OF TUNNEL LININGS WITH CONSIDERATION OF THE REAL CONDITIONS OF CONTACT OF THE STRUCTURE WITH SOIL,
I. A. Baslavskii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 214-216, October 1985. 1 ref. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Hydraulic structures, *Tunnels, *Stress analysis, *Hydraulic engineering, *Mechanical engineering, Tensile stress, Shear stress, Tension, Engineering.

When calculating linings of hydraulic tunnels, an important and complex problem is consideration of the conditions at the lining-soil contact. The normal stresses on the contact surface can be only compressive, and the shear stresses cannot exceed the limiting values of the frictional forces. An analogous problem is found when calculating retaining walls, beams, and other structures resting on soil. The iterative method with exclusion of all members which according to the results of the preceding iteration were under tension is used for calculating systems with unilateral members. Improvements call for excluding at each iteration only part of the tension members with maximum forces, eliminating the danger of endless cycling of the calculation. Consideration of restriction of tangential reactions causes great difficulties in the calculation. Recommended methods give only an approximate solution of the problem. This paper proposes a solution, which can be used also when developing programs for calculating other hydraulic structures. (Doria-PTT)
W87-01380

ESTIMATION OF THE RELIABILITY OF CONCRETE GRAVITY DAMS UNDER SEISMIC LOADS WITHIN THE FRAMEWORK OF THE STANDARD METHOD,
For primary bibliographic entry see Field 8F.
W87-01381

SUBSTANTIATION OF THE SELECTION OF THE DESIGNS OF A HYDRAULIC-FILL DAM FOR THE UPPER RESERVOIRS OF PUMPED-STORAGE STATIONS,
V. A. Melent'ev, and I. M. Mityushina.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 5, p 241-246, November 1985. 2 fig, 2 tab, 10 ref. Translated from Gidrotekhnische Stroitel'stro, No. 5, May 1985.

Descriptors: *Hydraulic design, *Hydraulic fill dams, *Reservoirs, *Pumped storage, *Dam design, Dams, Storage, Technology, Dam construction, Construction, Hydraulic structures.

The expediency of using various designs of hydraulic-fill dams for the upper reservoirs of pumped-storage stations (PSSs) is examined. Basic requirements imposed on these dams include: the dam should have increased permeability to minimize seepage losses; and the upstream shoulders should be composed of soil readily transmitting and rapidly yielding water. Dam designs investigated and compared on the basis of construction technology and calculations of seepage from the upper reservoir include: hydraulic-fill homogeneous sand dams; inhomogeneous gravel-sand dams with a hydraulic-fill loamy sand-loam core; and inhomogeneous hydraulic-fill gravel-sand dams with a placed loam core. On this basis, the authors recommend dams which have reliable impervious elements, namely, a diaphragm, facing, or placed clay core. (Doria-PTT)
W87-01383

PROTECTION OF NATURAL BANKS OF RESERVOIRS AT PLACES OF THEIR INTERSECTION BY PIPELINES,
V. I. Evdokimov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 5, p 247-252, November 1985. 5 fig, 10 ref. Translated from Gidrotekhnische Stroitel'stro, No. 5, May 1985.

Descriptors: *Bank protection, *Reservoirs, *Pipelines, *Banks, Shores, Protection, Structural engineering, Engineering, USSR.

Two types of pipeline protection are used on stretches of the natural banks of reservoirs intersected by pipelines: emergency and planned. In turn, planned protection is divided into protection of the stretch of the bank at the place of its intersection by each line (pipe protection) and protection of the entire bank in the zone of passage (bank revetment). Seven stretches of pipeline crossings across two reservoirs in the USSR were examined at the places where the lines of pipes intersect the abrasion banks (28 lines). Pipes were exposed in six stretches in various degrees (initial, progressive, and threatening). The design and effectiveness of the protective structures in place are described and evaluated. It is concluded that the creation of such structures should be based on a thorough and regular study of reservoir bank reworking processes at places of planned and existing pipeline crossings. (Doria-PTT)
W87-01384

METHODS OF GEODETIC MEASUREMENTS OF THE FOUNDATIONS OF HIGH DAMS,
For primary bibliographic entry see Field 8G.
W87-01387

CRITERIA OF SAFE OPERATIONAL DEFORMATIONS OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W87-01388

TRENDS IN SPILLWAY DESIGNS WITH CONSIDERATION OF CAVITATION, VIBRATION, AND DYNAMIC LOADS,
L. A. Zolotov, and V. M. Semenkov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 321-328, January 1986. 7 fig, 2 tab, 4 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Spillways, *Hydraulic design, *Cavitation, *Vibrations, Hydraulic structures, Flow, Hydroelectric plants, Powerplants, Environmental protection, Hydraulic engineering, Engineering.

The shift of large hydropower construction to regions with complex natural conditions, permafrost, harsh climate, and high seismicity determines the main trends in selecting the layouts of hydrostations and compositions and type of spillways.

The most common are overflow spillways located on the channel parts of dams or banks. Future trends will include increased use of deep (bottom) and tunnel spillways, increase of spillway capacity, and decrease of the operating heads of overflow spillways. The trend towards an increase of heads acting on tunnel and pipe spillways entails an increase in the cavitation and dynamic loads on their structural elements. Control of cavitation erosion of high-velocity spillways is being carried out by artificial aeration of the flow. Detailed dynamic calculations and model investigations of structures are required to solve problems of hydrodynamic and mechanical loads. Studies show an increase of vibration of a concrete spillway with the course of time and certain previously unknown characteristics of vibration of hydraulic structures. Self-synchronization of vibrations of apron platforms during discharge of a high flood have resulted in wave propagation and vibration of houses. These phenomena are in need of study. (Doria-PTT)
W87-01393

OPTIMIZATION OF THE DESIGNS OF EARTH DAMS,
L. N. Rasskazov, and I. L. Orekhova.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 361-368, January 1986. 5 fig, 7 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Hydraulic design, *Optimization, *Earth dams, *Dam design, *Structural engineering, *Systems analysis, Dams, Hydraulic structures, Dam construction, Stress, Strain, Stress analysis.

A method for optimizing the designs of earth dams based on elements of the mathematical theory of experimental design, the analytical theory of games, and systems analysis is proposed. The successful solution of the problem of constructing various functions of performance depends on the correctness of selecting the absolute dimensions of factor space, which is achieved by a thorough analysis of the available a priori information. Extreme narrowing of factor space results in the optimum solution's falling outside the limits of factor space. The number of factors should be limited to four or five, and complete factorial experiments should be used. In the case when the Pareto set does not intersect factor space, it is necessary to search for the point on the boundary of factor space closest to the point of the global optimum. In this case, the gradient, maximum descent, and other methods are used. (Doria-PTT)
W87-01399

USE OF HYDRAULICKING IN SIBERIA IN THE WINTER,
For primary bibliographic entry see Field 8B.
W87-01403

SMALL HYDROPOWER ENGINEERING IN THE GEORGIAN SSR,
For primary bibliographic entry see Field 8C.
W87-01404

SERVICEABILITY OF AN EARTH DAM WITH A REINFORCED-CONCRETE FACING,
A. A. Belyakov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 404-414, February 1986. 7 fig, 7 ref. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Earth dams, *Reinforced concrete, *Hydraulic design, *Dam design, *Dam stability, Concretes, Dams, Cracks, Mechanical failure, Stress analysis, Deformation, Stress, Strain.

The use of a combined approach based on the solution of two- and three-dimensional problems of the stress-strain state made it possible to analyze the serviceability of a high dam composed of gravel and stone with a reinforced-concrete facing under three-dimensional conditions with a site coefficient 2. The absolute values of the dimensions of the structure and site affect the development of the arching effect in the dam. A dam with a compressed profile made of gravel and stone with a reinforced-concrete facing with a height of 335 m is quite deformable and unstable, especially in the case of a decrease of the quality of placing the soils. However, due to the three-dimensionality of the work of the structure, its deformations decrease by at least twofold and stability increases by 1.5 times. A decrease of the scale of the linear dimensions of a dam with a reinforced-concrete facing by half substantially decreases its deformations and increases the stability. Consequently, to ensure a high reliability of structures of such type, they must be constructed with a height of not more than 180-200 m. On the other hand, the desirability of regular inspection of the facing, especially in the first years of operation of the dam, limits the area of use of such dams to seasonal reservoirs. (Doria-PTT)
W87-01405

PLACEMENT OF ALLUVIAL SANDS IN THE CHANNEL DAM OF THE TYUYAMUYUN HYDRO DEVELOPMENT,
V. I. Korsuntsev, and K. I. Tursunbaev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 415-419, February 1986. 5 fig, 1 tab, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Alluvium, *Sand, *Channels, *Dams, *Hydraulic design, Hydraulic structures, Hydraulic fill, Dam construction, Soil properties, USSR.

Investigations conducted during the design of the Tyuyamuyun hydro development led to the following conclusions. With layerwise placement of sand with rolling, the placement density is 0.10 g per cu m higher than with the hydraulic-fill method of placement. Placement of sand with rolling by 25-30-ton pneumatic-tire rollers should be done in layers of 30 cm each and compacted in six passes. In this case, the value of the optimal moisture content of compacting the sand is 10-14%. Soils in hydraulic-fill stockpiles are inhomogeneous with respect to compactibility. Approaching the discharge wells, the soil is finer and more inhomogeneous. With increase of the content of coarse fractions greater than 0.25 mm in the soil composition to 50-60%, its compactibility increases. With increase of the content of coarse fractions to more than 60%, the value of the unit weight decreases. The required placement density of fine and medium sands can be assigned on the basis of both the data of standard compaction by an impacter and the data of experiments to determine the densest possible state. (Doria-PTT)
W87-01406

EFFECT OF THE LENGTH OF DOWNSTREAM PIERS ON THE DISCHARGE REGIME OF BOTTOM SPILLWAYS,
For primary bibliographic entry see Field 8B.
W87-01407

CONDITIONS OF THE COMBINED STATIC WORK OF A PRECAST CONCRETE-ENCASED STEEL CONDUIT AND PILE GRILLAGE,
S. A. Berezinskii, E. A. Kogan, Y. B. Mgalobelov, and L. D. Solov'eva.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 432-437, February 1986. 5 fig, 1 tab, 3 ref. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Conduits, *Steel pipe, *Structural engineering, *Precast concrete, Concretes, Hydraulic design, Deformation, Concrete stability, Engineering.

Some of the main factors determining the rigidity of concrete-encased steel conduit sections in a longitudinal direction are investigated. The rigidity of the interacting structure of a large-diameter conduit and pile grillage is considerably higher than the rigidity of capping beams, which leads to a decrease of forces in the capping beams and increases the bearing capacity and reliability of the conduit. Consideration of the combined work of the conduit and pile grillage makes possible reduced consumption of reinforcement in the capping beams and equalization of the deformations of the foundation within the section. The combined work of precast elements of a concrete-encased steel conduit of a pumped-storage station and pile grillage is provided by welding the embedded parts of the precast elements and capping beams, and also by high-quality sealing of the joints between elements. The static work of the precast structure then becomes close to the work of a monolithic structure. (Doria-PTT)
W87-01408

SEWER REHAB USING A NEW SUBAREA METHOD,
RJN Environmental Associates, Inc., College Park, MD.
For primary bibliographic entry see Field 5D.
W87-01412

ROLLER COMPACTED CONCRETE DEVELOPMENTS IN THE USA,
Portland Cement Association, Denver, CO.
For primary bibliographic entry see Field 8F.
W87-01416

ROLLCRETE: SOME APPLICATIONS TO DAMS IN SOUTH AFRICA,
Department of Water Affairs, Forestry and Environmental Conservation, Pretoria (South Africa).
For primary bibliographic entry see Field 8F.
W87-01417

DESIGN CONSIDERATIONS FOR ROLLER-COMPACTED CONCRETE DAMS,
Malcolm Pirnie, Inc., White Plains, NY.
For primary bibliographic entry see Field 8F.
W87-01418

CONSTRUCTION OF THE MIDDLE FORK AND GALESVILLE R.C.C. DAMS,
Morrison-Knudsen Engineers, Inc., San Francisco, CA.
For primary bibliographic entry see Field 8F.
W87-01419

SLURRY WALL INSTALLATION BY THE VIBRATED BEAM TECHNIQUE,
F. C. Schmednecht, and K. P. Goldbach.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 27-29.

Descriptors: *Pollution control, *Slurry walls, *Cutoff walls, *Vibrating beam technique, *Groundwater pollution, *Construction equipment, *Water pollution control, Construction methods, Dams, Levees, Cutoffs.

The vibrating beam technique of installing thin slurry walls was introduced in Europe approximately 25 years ago. The vibratory driver-extractor was developed and entered into the commerical market in the late 1950s, providing a machine that could both drive and extract a pile without changing from a conventional hammer to an extractor. The vibratory driver-extractor permitted reusing the same beam element and overlapping with the previous beam insertion to form a continuous wall. A wide-flange beam was used to provide sufficient bending resistance to a wider beam while maintaining a thin web. The vibrating beam technique has been used successfully to install more than 50,000,000 sq ft of thin slurry wall in Europe with no known failures. In the United States since 1975, nearly 4,000,000 sq ft have been installed successfully by Slurry Systems Inc. in a variety of applications, primarily as: (1) Permanent seepage cutoffs either in new or existing dams or levees; (2) Temporary control of groundwater during construction; and (3) Barriers for the containment of toxic wastes. This paper describes the equipment, slurry types, and construction tech-

niques for installing the slurry wall and its applications. (See also W87-01669) (Lantz-PTT)
W87-01673

PERFORMANCE OF SOIL-CEMENT DAM FACINGS: 20-YEAR REPORT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8D.
W87-01757

MISSISSIPPI RIVER PASSES PHYSICAL MODEL STUDY: REPORT 2, SHOALING AND HYDRAULIC INVESTIGATIONS IN SOUTHWEST PASS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
H. A. Benson, and R. A. Boland Jr.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA166777, A09 in paper copy, A01 in microfiche. Technical Report HL-86-1, January 1986. Report 2 of a Series. 180 p, 2 fig, 30 tab, 55 plates, append.

Descriptors: *Mississippi River, *Model studies, *Shoals, *Hydraulic properties, *Southwest Pass, Hydraulic models, Channels, Spur dikes, Jetties, Sediment basins, Sediment transport.

Maintenance of Southwest Pass, one of the three major outlets of the Mississippi River, is a continuing and expensive problem due to extensive shoaling, primarily near the ends of the jetties and, to some extent, throughout the entire length of the pass. This report and Appendix A present the results of the model studies conducted to determine the effectiveness of proposed plans (e.g., lateral spur dikes, sediment diversion channel, sediment basin, relocation of the jetty channel, lateral spur dike extension, and friction chambers) for the elimination or reduction of maintenance dredging in Southwest Pass and in the jetty and bar channels. These results indicate some slight reductions in overall channel shoaling. Most of the test results indicate that there would be a redistribution of the shoal material in Southwest Pass, however, none of the plans tested caused movement of a significant quantity of shoal material into the Gulf. (Author's abstract)
W87-01759

MORPHOLOGIC EFFECTS OF LOWER MISSISSIPPI RIVER DIKE FIELDS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2J.
W87-01760

8B. Hydraulics

DISCHARGE CHARACTERISTICS OF LOCAL, DISCONTINUOUS CONTRACTIONS,
Ecole Polytechnique Federale de Lausanne (Switzerland).
W. H. Hager, and P. A. Dupraz.
Journal of Hydraulic Research, Vol. 23, No. 5, p 421-433, 1985. 8 fig, 10 ref, append.

Descriptors: *Hydraulic geometry, *Flow discharge, *Channel flow, *Hydraulic models, *Mathematical equations, Hydraulic engineering, Hydraulic grade, Hydraulic properties, Hydraulic structures, Flow pattern, Surface flow, Critical flow.

Local discontinuous contractions present discharge characteristics for critical flow conditions at the hydrodynamically contracted cross-section. It is concluded that correct application of the longitudinal momentum and energy theorems allows determination of the contraction coefficient in terms of the inlet angle, contraction ratio and relative contraction length. Theoretical results compare favorably with laboratory observations. Design diagrams are provided to enable rapid and simple determination of pertinent hydraulic quantities. (Michael-PTT)
W87-01113

SEDIMENT TRANSFER TO OVERBANK SECTIONS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W87-01114

ANALYTICAL SOLUTION OF LEAF-SHAPED BASIN FLOW,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-01116

HYDRODYNAMIC PRESSURES ON RIGID DAMS DURING EARTHQUAKES,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 8B.
W87-01256

HYDRODYNAMIC PRESSURES ON RIGID DAMS DURING EARTHQUAKES,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
P. L.-F. Liu.
Journal of Fluid Mechanics JFLSA7, Vol. 165, p 131-145, April 1986. 9 fig, 19 ref, append.

Descriptors: *Rock mechanics, *Hydraulic structures, *Earthquakes, *Hydrodynamics, *Dams, Mathematical studies, Pressure distribution.

A two-dimensional potential-flow theory is used to examine the hydrodynamic pressures acting on the surface of a rigid dam during earthquakes. An analytical solution is presented for the earthquake-acceleration-induced hydrodynamic pressure on a dam retaining a triangularly shaped reservoir. Both vertical and horizontal ground motions are considered. A general numerical scheme via an integral-equation formulation is also presented for complex geometries. Both analytical and numerical solutions agree well with the experimental data of Zangar (1953). (Cassar-PTT)
W87-01256

DYNAMIC ROUGHNESS AND THE TRANSITION BETWEEN WIND WAVE REGIMES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
J. S. Gulliver, and C. C. S. Song.
Journal of Geophysical Research (C) JGRCEY, Vol. 91, No. 4, p 5145-5151, April 15, 1986. 6 fig, 31 ref.

Descriptors: *Hydraulics, *Waves, *Roughness coefficient, Wind waves, Dynamic roughness, Surface drag, Capillary waves, Gravity waves, Wind shear, Fetch, Shear velocity, Water surface, Mathematical studies.

A variational principle applicable to a closed and dissipative mechanical system is applied to wind waves. The result of this principle is that the water surface will take the form that provides the greatest surface drag and maximizes surface drag coefficient, or dynamic roughness. Therefore, the normal train of logic is reversed: a maximum dynamic roughness is the criterion for gravity waves, capillary waves, or a hydraulically smooth water surface. Equations are assembled for the dynamic roughness of the water surface, and the variational principle is applied to find the transition between gravity and capillary waves and between capillary waves and a smooth water surface. It is found that wind fetch has no effect upon the point of transition from capillary to gravity waves. The transition between a smooth water surface and capillary waves, however, was found to depend upon both wind shear and fetch. The shear velocity of the transition increases with increasing fetch. (Author's abstract)
W87-01271

FORMATION OF AN EROSION PIT IN A STILLING BASIN: A CONSEQUENCE OF CAVITATION, (LA FORMATION D'UNE FOSSE D'EROSION DANS UN BASSIN DE DISSIPATION: UNE CONSEQUENCE DE LA CAVITATION),
Coyne et Bellier, Paris (France).
For primary bibliographic entry see Field 2J.
W87-01328

INVESTIGATION OF BRANCHED CHANNELS OF DELTAS,
L. N. Aleksandrov, T. D. Kumina, A. S. Marchenko, and L. B. Chudinova.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 12-16, July 1985. 4 fig, 4 ref. Translated from Gidrotekhnische Stroitel'stro, No. 1, January 1985.

Descriptors: *Channels, *Deltas, *Hydraulics, *Flow, *River forecasting, *Weirs, Economic aspects, Dynamics, Rivers, Model studies, Mathematical studies.

Methods are described for creation of optimal hydraulic regimes in river deltas. For increasing the discharge into a main distributary, the authors recommend a free groin placed at the branch point as a continuation of the bank. An equation is presented by which its length can be determined on the basis of the required degree of changing the discharge. Since a submerged weir located in a lateral distributary does not have a significant effect on the redistribution of discharges, its placement to increase the discharge in the main distributary is not rational. The placement of a submerged weir in the main distributary can be recommended for reviving a lateral distributary (increasing the discharge). A graph is presented by which the location and height of this structure can be determined as a function of the required degree of changing the discharge. (Doria-PTT)
W87-01352

TRANSIENT CHARACTER OF A TURBIDITY CURRENT IN A RESERVOIR,
Y. G. Pyrkin, B. I. Samolyubov, D. N. Nabotov, and S. M. Eshniezov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 2, p 85-88, August 1985. 3 fig, 10 ref. Translated from Gidrotekhnische Stroitel'stro, No. 2, February 1985.

Descriptors: *Turbidity currents, *Underflow, *Density currents, *Reservoirs, Water currents, Sediment transport, Suspended sediments, Sediments.

In a turbidity current, a transient character during the daily cycles is determined by a change in the regime of inflow of sediments into the reservoir and by eddy-wave structures developing on the outer boundaries of a density flow. The first factor can be taken into account for a known daily variation of the liquid discharge of the river feeding the density current. The second type of transient character of the current is determined by the effect of turbulence being generated in the contact zones of the current, the intensity of which can be expressed by an equation presented in the text, using the coefficient of entrainment of the ambient fluid into the flow. (Doria-PTT)
W87-01360

CHARACTERISTICS OF THE ICE AND THERMAL REGIME OF THE GUNT RIVER IN CONNECTION WITH THE DESIGN OF THE PAMIR HYDROELECTRIC STATION,
S. M. Sherman.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 141-146, September 1985. 2 fig, 3 tab, 4 ref. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Gunt River, *Pamir, *Ice, *Hydraulic design, *Hydroelectric plants, *Thermal properties, Powerplants, Electric power production, Hydrothermal studies, Ice formation, Frazil ice, Ice jams, USSR.

During a winter of normal severity, a stretch of the site of the Pamir No. 1 hydrostation is in a zone of

increased probability of icing. It is necessary to use structural and regime measures to prevent icing of the stationary parts of gates and to provide for heating of the trash racks. To prevent the flow of frazil slush (shuga) to the water intake, it is advisable to construct a retaining boom. The stretch of the Gunt River at Novobad, where the width of the floodplain reaches 200 m, will permit accumulating the shuga runoff under conditions of seasonal regulation by Lake Yashil'kul, and is recommended for this purpose. The discharge of groundwaters (springs) in this stretch will limit the development of ice-jam horizons. (Doria-PTT)
W87-01368

CALCULATION OF THE SIZE OF ICE HUMMOCKS,
For primary bibliographic entry see Field 2C.
W87-01369

DEFORMATION OF RIVER CHANNELS IN THE DAM STRETCH,
V. M. Zubets, and V. N. Stankevich.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 150-153, March 1985. 2 fig, 1 tab, 9 ref.

Descriptors: *Rivers, *Channel scour, *Dams, *Scour, *Aggradation, *Channel morphology, Hydrology, Flow, Sediment load, Reservoirs, Deformation, Water level, Water level fluctuations, Fluctuations.

The construction of small reservoirs changes the natural hydrologic regime of rivers, expressed mainly in the annual redistribution of water discharge and partial or complete retention of the sediment load by the reservoir. Scour of river channels in the lower pool, observed during operation of large reservoirs, usually results in a drop of the water level and bottom, although sometimes a rise of the bottom and water surface is noted. An investigation of deformations in the dam stretch of small reservoirs in Belorussia showed than an analogous phenomenon of a rise of the bottom and water surface occurs in almost all cases. An equation is developed for forecasting deformations of channels in the lower pools of small reservoirs on rivers composed of noncohesive soils. (Doria-PTT)
W87-01370

ENERGY LOSSES OF A CHANNEL FLOW UNDER CONDITIONS OF OVERFLOW ONTO A FLOODPLAIN,
V. G. Salikov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 6, p 295-301, December 1985. 4 fig, 1 tab, 11 ref. Translated from Gidrotekhnische Stroitel'stro, No. 6, June 1985.

Descriptors: *Floods, *Energy loss, *Channels, *Flow, *Overflow, *Flood plains, *Hydraulic engineering, Engineering, Hydraulics, Model studies, Fluid flow, Flow channels, Hydraulic models, Flow characteristics.

The main types of interaction of channel and floodplain flows are distinguished and described by the equation of fluid motion with a variable discharge. The effect of overflow onto the floodplain on the energy losses and other characteristics of the channel flow is established, and relations are obtained which can be used on hydraulic calculations of river flows in the range of investigations conducted (under conditions of intersection of the main channel by a 'through-going' floodplain with angles of turn of the meander 80 to 106 degrees and meeting certain other specifications). (Doria-PTT)
W87-01389

CANALS IN COHESIVE SOILS,
T. A. Aliev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 6, p 301-307, December 1985. 4 tab, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 6, June 1985.

Descriptors: *Canals, *Cohesive soils, *Channel erosion, *Hydraulics, Soils, Erosion, Deformation, Sediments, Channels, Mathematical studies.

The process of channel erosion is investigated for canals running in cohesive soils. A physical substantiation of the dimensionless group M sub r as a parameter of the resistance of the channel to erosion is given and other dimensionless groups (the flow-channel system) are included in it. New dimensionless groups are proposed for characterizing the channel shape. Equations are presented for estimating the hydraulic parameters of a stable channel, by means of which the values of the lower limit of the canal channel shape parameter can be determined. Additional equations, along with the equations of motion of water, continuity, and channel deformation serve for determining the hydraulic parameters of the canal during general erosion. (Doria-PTT)
W87-01390

SOME PRESSING PROBLEMS OF CANAL HYDRAULICS,
A. V. Mishuev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 339-345, January 1986. 4 fig. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Canals, *Hydraulics, *Erosion, *Channel flow, Channel erosion, Hydraulic engineering, Engineering, Flow, Channels.

Unlined canals are often subjected to erosion, despite the fact that flow velocities not exceeding the eroding velocities were used when designing them. Deformation of the originally prismatic channel accompanying erosion and their transformation not only at bends but also on long straight stretches lead to their shoaling and widening in plan, reducing their capacity. The causes of erosion are related to two phenomena: swinging of the flow in the canal, and increased flow velocities near the water's edge during passage of steep surge waves. These problems are investigated mathematically. It is concluded that the kinematics of steady and unsteady (wave) flow in a canal described by two-dimensional equations of hydrodynamics reveal the characteristics being displayed in the occurrence of large velocities on the slope eroding the channel. (Doria-PTT)
W87-01395

CALCULATION OF WAVE LOADS ON VERTICAL WALLS AND STREAMLINED BARRIERS,
D. D. Lappo.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 345-352, January 1986. 5 fig, 3 tab, 11 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Waves, *Barriers, *Hydraulic structures, *Hydrodynamics, *Wind waves, Mathematical studies, Statistical analysis, Hydraulic design, Hydraulic engineering, Water currents.

Studies of the interaction of waves with marine hydraulic structures consider the dynamic character of the process and the problem of the irregularity of waves. It has been shown that for structures of a vertical profile, the calculations of loads performed with respect to a monochrome give in the first approximation the same result as with consideration of irregularity of waves. The solution of this problem has been reduced to calculation of the statistical characteristics of the forces occurring under the effect of waves, in which case the structure was assumed absolutely rigid and the energy spectrum of the three-dimensional irregular waves was assumed known. The method analyzes the process of interaction of one spectral component with the structure and provides subsequent summation of the particular solutions by formulas of probability theory. These studies are described and equations provided. (Doria-PTT)
W87-01396

NEW DESIGN OF TAILRACE CONDUITS OF HYDROPOWER PLANTS,
G. I. Krivchenko, E. V. Kvyatkovskaya, A. B. Vasil'ev, and V. B. Vladimirov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 352-357, January 1986. 3 fig, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Tailraces, *Conduits, *Hydroelectric plants, *Hydraulic design, *Hydraulic structures, Powerplants, Pumping plants, Pumped storage, Storage, Construction, Structural engineering, Engineering.

The new design of the tailrace conduit for hydropower plants differs from those used earlier in that the elevations of the top of its roof gradually increase toward the free pool. Depending on the position of the lower pool level, the operating regime of the conduit can be either pressure (at high elevations of the lower pool), or partially pressure and partially free-flow, or free-flow (at low elevations of the lower pool). The geometry of the line of the longitudinal profile of the tunnel ceiling is determined by a calculation based on the condition of no discontinuity of the flow beyond the runner. The new design reduces the volume of works and associated costs, and is especially recommended under conditions of considerable fluctuations of the lower pool level with lengths of the downstream conduits of about 150-600 m. The use of conduits of a mixed design, in which the initial stretch of the conduit is made with a rising ceiling and the end stretch is free-flow, is possible. (Doria-PTT)
W87-01397

REGIMES OF PASSAGE OF HIGH FLOODS THROUGH THE CASCADE OF HYDROSTATIONS ON THE VOLGA AND KAMA RIVERS,
For primary bibliographic entry see Field 2E.
W87-01398

CALCULATION OF INSTANTANEOUS BOTTOM VELOCITIES FOR A SURFACE REGIME OF CONJUGATION OF POOLS,
S. M. Slisskii, and K. A. Grigoryan.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 368-373, January 1986. 4 fig, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Spillway design, *Hydrological regime, *Scour, *Stability analysis, Hydroelectric plants, Powerplants, Flow, Channels, Velocity, Average velocity, Mathematical studies.

The apron behind spillway structures or block hydroelectric stations can be made in the form of riprap. Calculation of stability of the noncohesive material in the flow can be performed on the basis of the average, mean bottom, or maximum instantaneous velocities. Calculation on the basis of maximum instantaneous bottom velocities is based on experimental data on change in these velocities over the length of the channel. In this case, the maximum fluctuation component of the velocity on the basis of the 'three-sigma' rule is usually assumed equal to 3 sigma, corresponding to a probability of exceeding this value of 0.997. Equations are provided and examples discussed. Calculation of the distance from the drop wall to the site of maximum instantaneous bottom velocity in the case of considerable three-dimensionality requires refinement as experimental data are accumulated. (Doria-PTT)
W87-01400

SCALE EFFECTS IN MODELING HYDRAULIC STRUCTURES,
G. V. Vasil'chenko.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 7, p 374-378, January 1986. 1 fig, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 7, July 1985.

Descriptors: *Model studies, *Hydraulic structures, *Hydraulic engineering, *Fluid flow, Flow, Hydraulic design, Mathematical studies.

Group 8B—Hydraulics

The International Association of Hydraulic Research symposium on scale effects in modeling hydraulic structures (September, 1984) is summarized. The symposium discussed practical and scientific aspects of using approximate modeling with consideration of scale effects for solving engineering problems and investigating various phenomena in fluid flows. Among topics covered were modeling of conduits and steady and unsteady flows; modeling aeration and air-water mixtures; and modeling separated flows (wakes) and energy dissipation in a flow, from hydraulic jumps to waves in sea ports. (Doria-PTT)
W87-01401

USE OF HYDRAULICKING IN SIBERIA IN THE WINTER,
B. V. Sadlei, and N. N. Kozhevnikov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 392-394, February 1986. 1 ref. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Hydraulicking, *Siberia, *Construction, *Earthworks, *Excavation, *Dredging, Hydraulic structures, Hydraulic fill, Hydraulic engineering, Kazakhstan, USSR.

The intense development of Siberia and eastern regions of Kazakhstan with their rapidly developing power and industrial construction requires the ever-wider use of hydraulicking, one of the most economical methods of earthworks when constructing hydraulic structures and extracting industrial minerals for the construction industry of these regions. Hydraulicking operations in the winter are complicated at all stages of the excavation, hydraulic transport, and hydraulic filling of soil because of freezing temperatures and ice formation at the working faces of the dredges and in the pipelines and hydraulic-fill plots. Measures are described to facilitate hydraulicking operations under these conditions. (Doria-PTT)
W87-01403

PLACEMENT OF ALLUVIAL SANDS IN THE CHANNEL DAM OF THE TYUYAMUYUN HYDRO DEVELOPMENT,
For primary bibliographic entry see Field 8A.
W87-01406

EFFECT OF THE LENGTH OF DOWNSTREAM PIERS ON THE DISCHARGE REGIME OF BOTTOM SPILLWAYS,
K. A. Grigoryan.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 419-421, February 1986. 2 fig, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Downstream effects, *Piers, *Hydrological regime, *Spillways, *Hydraulic design, Hydraulic structures, Gates, Dam design, Hydraulic engineering, Dams, Tunnel construction.

When diverting water during construction through pressure spillways in a dam or pressure tunnel, gates can be installed at the outlet of the conduit. When the gates are installed on the downstream side, it is necessary to provide nonsubmergence of the gate. Submergence of the gate causes considerable pulsating hydrodynamic loads on the gate chamber and gate, and the capacity of the spillway decreases due to a decrease of the effective head. To provide an unsubmerged discharge regime, the outlet openings are located on a ledge. A method is given for calculating the depths of the lower pool at which submergence of the spillway openings on a ledge occurs in the presence of a platform beyond the opening. (Doria-PTT)
W87-01407

INVESTIGATIONS INTO BLADE FAILURES OF FRANCIS TURBINES,
Bharat Heavy Electricals Ltd., Hyderabad (India). Corporate R and D Div.
For primary bibliographic entry see Field 8C.
W87-01421

STUDY ON GENERATION OF PERIODICAL LARGE SURFACE EDDIES IN A COMPOSITE CHANNEL FLOW,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-01453

SURFACE IRRIGATION ADVANCE MOTION AFTER GATE CLOSURE,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
G. J. Weir.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1409-1414, September 1985. 1 tab, 9 ref, 2 append.

Descriptors: *Surface irrigation, *Kinematic wave theory, *Model studies, *Border irrigation, *Advance front motion, Irrigation, Surface water, Water, Surface flow, Infiltration.

A kinematic wave model of border dike irrigation is presented in which surface discharge per unit width varies as the square of surface depth, and the cumulative infiltration is a linear function of the opportunity time. Analytic approximations are presented for the motion of the advance front after gate closure. These results, which are usually accurate to within 1%, are obtained by considering the surface water profile at the instant the depletion characteristic reaches the advance front, and the subsequent advance motion, to have originated from an idealized, fictional water source concentrated about the gate at the time of gate closure. In order to use these approximations, a parameter is determined at the time of arrival of the depletion characteristic, and henceforth a check must be made that the second advance curve always precedes the recession curve. The maximum error always occurs at the recession distance XR, since the analytic approximations for the second advance curve have nonzero speed at XR. The classification of solutions is conceptually simplified when both of the infiltration parameters are nonzero. The corresponding Lewis-Milne problem also is briefly discussed. (Doria-PTT)
W87-01535

EFFECTS OF SUSPENDED SEDIMENT ON THE OPEN-CHANNEL VELOCITY DISTRIBUTION,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W87-01587

HODOGRAPH TRANSFORMATION FOR FLOW THROUGH A DAM WITH SLOPING WALLS AND NO TAIL WATER,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
C. W. Boast.
Water Resources Research WRERAO, Vol. 22, No. 10, p 1455-1461, September 1986. 7 fig, 20 ref.

Descriptors: *Hodographs, *Flow velocity, *Dams, *Sloping walls, *Mathematical analysis, Slopes, Earth dams, Tailwater, Poisson ratio, Flow pattern, Transformation.

A method is presented to transform the hodograph plane (velocity plane) of an earthen dam with sloping walls, to a plane where the unconfined saturated-flow boundary value problem associated with such a dam can be solved using the Poisson integral. The solution would give, for example, the rate of flow of water through the dam, the extent of the surface of seepage on the downstream side of the dam, and the shape and position of the water table within the dam. The method, which is presented for the no-tailwater case, applies to a dam with perpendicular upstream and downstream walls, and is based on the fact that the hodograph of such a dam consists simply of a triangle, plus an internal circular arc cut that represents the water table. A key step in the method is possible because, in the plane generated by the first Schwarz-Christoffel transformation, the curve corresponding to the water table approaches a parabola near the point at infinity. (Author's abstract)
W87-01595

OPTIMIZING PUMPING STRATEGIES FOR CONTAMINANT STUDIES AND REMEDIAL ACTIONS,
Robert S. Kerr Environmental Research Lab., Ada, OK. Ground Water Research Branch.
For primary bibliographic entry see Field 5G.
W87-01674

HYDRODYNAMIC ISOLATION IN HAZARDOUS WASTE CONTAINMENT,
For primary bibliographic entry see Field 5G.
W87-01675

DETERMINING OPTIMUM PUMPING RATES FOR CREATION OF HYDRAULIC BARRIERS TO GROUND WATER POLLUTANT MIGRATION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W87-01676

DOUBLE-CELL HYDRAULIC CONTAINMENT OF POLLUTANT PLUMES,
For primary bibliographic entry see Field 5G.
W87-01677

8C. Hydraulic Machinery

NEW APPROACH TO TREATMENT PLANT DESIGN AND CONSTRUCTION IN LATIN AMERICA,
Hidrosan Ltd., Bogota (Colombia).
For primary bibliographic entry see Field 5F.
W87-01026

ON-SITE MARKING OF THE AXES OF THE STRUCTURES OF THE SHUL'BINSK HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W87-01351

WATER-MANAGEMENT AND POWER USE OF THE ARAKS RIVER,
For primary bibliographic entry see Field 8A.
W87-01356

EVALUATION OF THE RELIABILITY OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8A.
W87-01357

INCREASE OF THE ENERGY EFFICIENCY OF THE REVERSIBLE BULB UNIT OF A TIDAL POWER STATION BY REGULATING THE ROTATIONAL SPEED,
S. G. Dmitriev, and A. V. Pikovskii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 2, p 55-61, August 1985. 5 fig, 1 tab, 4 ref. Translated from Gidroteckhnische Stroilte'stro, No. 2, February 1985.

Descriptors: *Energy, *Tidal powerplants, *Hydroelectric plants, *Electrical equipment, *Generators, Powerplants, Turbines, Electric power production, Hydroelectric power, Electric power, USSR.

A synchronous induction motor-generator provides reliable regulation of the rotational speed of the bulb unit of a tidal power station in wide limits. For conditions of the Kislaya Guga tidal power station, regulation of the rotational speed makes it possible to increase efficiency in a forward turbine regime (double regulation) by 4.5% and in a reversed turbine regime (single regulation) by 11.2%. In addition to increasing the efficiency of the unit, regulation of the rotational speed increases the maximum power at heads less than the design. The power effect of using rotational speed regulation for the unit as a whole decreases somewhat in connection with a decrease of efficiency at low

speeds. Regulation of the rotational speed makes it possible to use units with single regulation at plants with a wide variation of the head and also provides a reduction of the level of unsteady loads in the water passageway. (Doria-PTT)
W87-01358

RESULTS OF ON-SITE OBSERVATIONS OF THE STATE OF STRUCTURES AT THE KANEV HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W87-01361

HYDROPOWER ENGINEERING OF THE NORTHERN CAUCASUS,
For primary bibliographic entry see Field 8A.
W87-01366

EXPERIENCE IN OPERATING THE HYDRAULIC STRUCTURES OF THE BORISOGLEBSK HYDROELECTRIC STATION,
D. M. Yashkul'.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 154-161, September 1985. 2 fig, 1 tab, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Borisoglebsk hydroelectric station, *Hydraulic structures, *Hydroelectric plants, Concrete dams, Spillways, Tunnels, Diversion structures, Powerplants, Dams, Seepage, USSR.

The long operating experience of the Borisoglebsk hydrostation (USSR) shows a sufficiently high level of reliability of the hydraulic structures. Most operating difficulties are related to rockfalls in the unsupported parts of the underground workings and to seepage into the tunnels and rooms. The repair and construction works on the hydro development are distinguished by a great diversity; their need inevitably increases with time as the structures age. (Doria-PTT)
W87-01371

OPERATION OF THE UNDERGROUND DIVERSION OF THE BORISOGLEBSK HYDROELECTRIC STATION,
D. M. Yashkul', and V. I. Kaminarov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 161-165, September 1985. 2 fig, 2 ref. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Borisoglebsk hydroelectric station, *Diversion structures, *Hydraulic structures, *Tunnels, *Conduits, Hydraulic engineering, Hydraulic design, Structural engineering, Engineering, USSR.

The results of observations and inspections of unlined tunnels of the Borisoglebsk hydroelectric station (USSR) prove that exfoliation of rock and falls of individual blocks should be regarded as an ordinary event accompanying tunnel operation. The construction of bottom traps (wells, pockets) should not be rejected. Only extensive support of the roof and walls over the entire surface can completely protect tunnels from exfoliation of rocks. This will require shutting down the hydrostation for a long time, and will result in considerable material expenditures. It is more rational to empty the tunnels for a short time periodically (e.g., every five years) to clear the accumulations of rock material. The installation of intercepting racks helps to reduce the amount of rock being carried by the flow to the units. On the whole, the operation of the tunnels of the Borisoglebsk hydrostation and their condition after clearing are considered completely satisfactory. (Doria-PTT)
W87-01372

MAIN HYDROPOWER EQUIPMENT OF THE FIRST SERIES OF PUMPED-STORAGE STATIONS,
M. F. Krasil'nikov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 167-174, October 1985. 4 fig, 2 tab, 2 ref. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Hydraulic equipment, *Pumped storage, *Hydroelectric plants, *Electrical equipment, Storage, Powerplants, Hydraulic machinery, Turbines, Pump turbines, USSR.

The diverse functions of a pumped-storage station (PSS) in the power system requires a high degree of speed, reliability, and trouble-free operation of the equipment under various steady and transient operating conditions. Unlike the usual units of a hydroelectric station, the reversible units of a PSS are subjected to considerably greater dynamic loads, more frequent starts and stops, and diversity of transients. The Zagorsk PSS was the first for which a set of technological equipment for a head of 100 m was developed in the USSR. This paper describes this equipment and its design parameters, including the reversible pump-turbines, regulating system, motor-generator, and switchgear, and the layout of the equipment. (Doria-PTT)
W87-01373

EXPERIENCE IN THE UNIFICATION OF STRUCTURES OF PUMPED-STORAGE STATIONS,
I. O. Agatov, S. A. Berezinskii, Y. N. Varichev, and I. E. Lomov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 175-179, October 1985. 3 fig, 4 ref. Translated from Gidrotekhnische Stroilte'stro, No. 4, April 1985.

Descriptors: *Pumped storage, *Hydraulic structures, *Hydroelectric plants, *Structural engineering, *Hydraulic design, Powerplants, Storage, Engineering, Hydraulic equipment, Construction, USSR.

The experience of designing the Zagorsk and Kaisiadorys pumped-storage stations (PSSs) in the USSR shows that the creation of unified designs for the structures of the powerhouse, penstocks, and intake is possible and expedient. These designs and layouts are being used when designing subsequent PSSs. Only the first steps have been taken in unifying the designs of PSSs, but they indicate the possibility of reducing labor expenditures in design. The creation and introduction of unified designs of PSSs permits carrying out specialization of construction organizations for performing construction and assembly works on penstocks, powerhouses, intakes, and reservoir retaining structures of PSSs. (Doria-PTT)
W87-01374

DESIGN OF PENSTOCKS OF PUMPED-STORAGE STATIONS,
S. A. Berezinskii, A. V. Egorov, V. S. Lashmanova, and I. A. Polinkovskii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 180-187, October 1985. 6 fig, 3 tab, 4 ref. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Penstocks, *Pumped storage, *Hydraulic design, *Hydraulic equipment, *Hydroelectric plants, Storage, Powerplants, Construction, Engineering, Structural engineering.

Steel penstocks are used for high-head diversion hydroelectric stations in open stretches, and reinforced-concrete penstocks are used for low- and medium-head reservoir hydroelectric stations. Two designs are used for high-head reservoir hydroelectric stations: either the conduit with a metal lining is located directly in the body of a massive dam, or the concrete-encased conduits extend from the body of the dam to the downstream face. When designing the penstocks of pumped-storage stations (PSSs), it is necessary to solve a wide range of new engineering problems, including selection of the route of the penstocks with consideration of the engineering-geologic conditions and general layout of the station. This paper examines the problem of the reliability of the designs of metal penstocks and reinforced-concrete and concrete-encased penstocks. (Doria-PTT)
W87-01375

INTAKE OF THE ZAGORSK AND KAISIADORYS PUMPED-STORAGE STATIONS,
S. A. Berezinskii, I. I. Ivanov, and M. F. Sarkisova.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 187-190, October 1985. 4 fig, 2 tab. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Intakes, *Pumped storage, *Hydraulic structures, *Hydroelectric plants, *Hydraulic design, Storage, Conduits, Powerplants, Hydraulics, Turbines, Pumps, USSR.

A new design of the intake-offtake with an extended portal was developed for the Zagorsk pumped-storage station (PSS). It is characterized by stable hydraulics of the flow, high energy characteristics in the turbine regime, and improved characteristics in the pump regime. Further improvement of the shape of the offtake (in a pump regime) is possible by greater compression of the outlet diverging duct (to 8-12 degrees) and elliptical shaping of the upper boundary of the portal. The elimination of the trash rack of the intake in the upper reservoir, the water area of which is confined and has special preparation of the bed and facing of the upper part of the slopes, reduces head losses and increases the operating efficiency of the PSS equipment. (Doria-PTT)
W87-01376

TECHNOLOGY OF MANUFACTURING PRECAST REINFORCED-CONCRETE ELEMENTS OF THE PENSTOCKS OF PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8F.
W87-01377

EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF THE KAISIADORYS PUMPED-STORAGE STATION,
I. M. Velaniahkis, and I. O. Agatov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 196-199, October 1985. 3 fig, 1 tab. Translated from Gidrotekhnishce Stroitel'stro, No. 4, April 1985.

Descriptors: *Pumped storage, *Construction, *Hydraulic structures, *Hydraulic design, *Hydraulic engineering, Storage, Penstocks, Reservoirs, Embankments, Geology, Structural engineering, Engineering.

The Kaisiadorys pumped-storage station (PSS) is located on the right bank of the Kaunus hydroelectric station at the mouth of the Streva River (USSR). Main structures include an upper storage reservoir; intake with wing walls; penstocks (eight lines); powerhouse complex, including powerhouse with assembly floor, wing walls, office building, and 330-kV and 100-kV outdoor electrical equipment; reversible canal; and lower reservoir. The design and construction of the PSS is described. Excavation of the pit in the silts was especially complicated. An important problem when excavating the pit at the foot of a long steep slope was the creation of a surface water diversion and drainage system to protect the slope and pit. (Doria-PTT)
W87-01378

SUBSTANTIATION OF THE SELECTION OF THE DESIGNS OF A HYDRAULIC-FILL DAM FOR THE UPPER RESERVOIRS OF PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8A.
W87-01383

EMERGENCY-GUARD GATE FOR A HIGH-HEAD OUTLET,
G. A. Chepaikin, and G. A. Ryabtsev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 5, p 255-257, November 1985. 2 fig, 3 ref. Translated from Gidrotekhnische Stroitel'stro, No. 5, May 1985.

Descriptors: *Gates, *Emergency-guard gates, *Outlets, *High-head outlets, *Hydraulic equipment, Hydroelectric plants, Powerplants.

An improved variant of the vertical-lift emergency-guard ring-follower gate is proposed that does not require the strong hermetic covering used in previous models. This is achieved by installation of additional outside common sealing contours on the gate, encompassing the existing individual closed sealing contours on the wicket and ring. With the usual 4 to 6 hermetic covers for deep outlets of high-head hydro projects, the new design will save 60,000 to 90,000 rubles and 80 to 120 tons of metal. Repair work on the gates also will be facilitated. (Doria-PTT)
W87-01386

CORROSION OF EMBEDDED PARTS OF INTAKE WORKS OF THE MINGECHAUR HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8G.
W87-01391

NEW DESIGN OF TAILRACE CONDUITS OF HYDROPOWER PLANTS,
For primary bibliographic entry see Field 8B.
W87-01397

SMALL HYDROPOWER ENGINEERING IN THE GEORGIAN SSR,
R. G. Avalishvili, V. A. Gogoberidze, T. V. Shvelidze, and G. M. Shul'ts.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 395-398, February 1986. 2 tab, 7 ref. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Hydroelectric power, *Hydraulic structures, *Hydraulic equipment, *Hydraulic engineering, *Hydroelectric plants, Electric power, Structural engineering, Engineering, Construction, Water resources development, Powerplants, Georgian SSR, USSR.

An analysis of the technical and economic indices of the operating small hydroelectric stations (SHESs) of the Georgian SSR shows the profitability of their operation. The following measures are recommended to increase their effectiveness: bringing their hydraulic structures into a proper condition; organizing the repair of hydropower equipment and providing it with the necessary spare parts; completely automating all SHESs to reduce their operating costs and simplifying control of their operation. For providing further continuous operation of the operating SHESs, reconstructing SHESs put out of commission because of wear of the equipment, and constructing new SHESs, it is necessary to organize the production of unified hydropower equipment and spare parts by manufacturers of the USSR Ministry of Power and Electrification. (Doria-PTT)
W87-01404

INVESTIGATION OF STRAY CURRENTS AND INCREASE OF THE SAFETY OF ELECTRIC BLASTING OPERATIONS,
For primary bibliographic entry see Field 8H.
W87-01409

CALCULATION OF THE PARAMETERS OF DRILLING AND BLASTING OPERATIONS TO OBTAIN PERMISSIBLE OVERBREAKS AND UNDERBREAKS AT FOUNDATIONS,
For primary bibliographic entry see Field 8H.
W87-01410

INVESTIGATIONS INTO BLADE FAILURES OF FRANCIS TURBINES,
Bharat Heavy Electricals Ltd., Hyderabad (India). Corporate R and D Div.
S. K. Bhave, C.B Murthy, and S. K. Goyal.
Water Power and Dam Construction, Vol. 38, No. 1, p 37-39, January 1986. 4 fig, 2 tab.

Descriptors: *Blade failures, *Francis turbines, *Hydroelectric power, *Runner blades, *Vibration measurement, Chemical examination, Microstructure examination, Dams, Construction material, Mechanical forces, Design, Asymetric flows.

In spite of highly refined techniques for predicting stress distribution in turbine blades, there are still many failures in service. The cause is seldom that of the underdimensioning, but frequently that of operating conditions. The results of five case studies are discussed and substantiate this view. The failure analysis of runner blades and similar components consist of the following steps: chemical and microstructure examination of construction material; fracture surface examination; measurement of mechanical and perturbation forces; identification of the natural vibration of the component; and residual stress measurement. (Main-PTT)
W87-01421

AUTOMATIC CONTROLS FOR SPILLWAY GATES AND OUTLETS,
Leyland, Watson and Noble, Auckland (New Zealand).
B. W. Leyland, G. R. Jessup, and S. R. Berry.
Water Power and Dam Construction, Vol 38, No. 1, p 40-43, January 1986. 10 fig, 4 ref.

Descriptors: *Dams, *Gates, *Outlets, *Spillways, New Zealand, Hydraulic circuits, Tipping buckets, Buoyant weight spillgates, Flap gates.

A significant proportion of dam failures are a result of spillway gate failure. Four automatically controlled gates recently installed and commissioned in New Zealand are described. Control systems for automatic gates must be designed and detailed with extreme care. Where simple, self-powered systems can be applied, they should be used in preference to more complicated and complex electro-hydraulic control and lifting gear. (Main-PTT)
W87-01422

PERFORMANCE TESTS ON TERTIARY GRANULAR MEDIA FILTERS,
Northwestern Univ., Evanston, IL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-01517

EVALUATION AND ANALYSIS OF MOTOR STARTING PROBLEMS AT FOUNTAIN VALLEY PUMPING PLANT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
B. Milano, M. L. Jacobs, and R. C. Arbour.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB85-244085, A06 in paper copy, A01 in microfiche. No. REC-ERC-84-22, March 1984. 122 p, 8 append.

Descriptors: *Electrical equipment, *Motors, *Pumping plants, *Fountain Valley, Colorado, Capacitors, Transformers, Fourier analysis, Harmonics, Performance evaluation.

Fountain Valley Pumping Plant No. 1 has four 700-hp, wound-rotor, induction motors fitted with slip loss and energy recovery systems manufactured by Anvic International. The slip loss recovery system essentially consists of a three-phase rectifier bridge and an inverter bridge. The rectifier converts rotor slip frequency a-c voltage to d.c. The inverter converts the d.c. to a.c. for power feedback into a 60-Hz, a-c system. In this scheme, the motor is able to operate at various speeds with substantially higher efficiency than a conventional, wound-rotor, variable-speed, induction motor with adjustable rotor resistors. The startup problems at Fountain Valley are due to an inadequate SCR (short circuit ratio) at the drive side of the feedback transformer is the predominate factor in determining the SCR to an unacceptably low value. The SCR and percent distortion factors should have been considered in the sizing of the feedback transformer. Neglecting this equipment coordination task resulted in the manufacturer selecting a feedback transformer considerably smaller than actually required for proper operation. An insertion resistor scheme during the initial startup period has proved successful in eliminating the startup problems. Insertion resistor starting eliminates the problem by reducing the SCR requirements of the drive. (Lantz-PTT)
W87-01756

8D. Soil Mechanics

FRACTURE PERMEABILITY AND GROUNDWATER FLOW IN CLAYEY TILL NEAR SASKATOON, SASKATCHEWAN,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W87-01041

WATERTIGHT ELEMENTS OF EARTH HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8G.
W87-01359

PREDICTION OF PARTICLE-SIZE DISTRIBUTION AND PROPERTIES OF SOILS OF A BLAST-FILLED DAM,
L. N. Rasskazov, T. C. Ngia, and V. F. Korchevskii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 5, p 223-233, November 1985. 14 fig, 1 tab, 13 ref. Translated from Gidrotekhnische Stroitel'stro, No. 5, May 1985.

Descriptors: *Particle size, *Distribution, *Dams, *Particle size distribution, *Soil physical properties, *Soil engineering, Soil density, Soil properties, Prediction, Stress, Deformation, Dam construction, Engineering, Mathematical studies.

Mechanical-mathematical model investigations are discussed for predicting size distribution and density of soil during formation of a dam. The dynamic stresses at various points of the dam differ from one another mainly by the time of action of the load, which increases with increase of depth of the calculated point. The intensity and decay of the dynamic stresses with depth depend on the characteristics of the dam material: the stiffer the material, the greater the stress intensity and the less the decay of stress with depth. Crushing and density of the soil increase with increase of the acting pressure. Crushing of soil decreases with increase of content of small fractions in the initial mixture. With increase of pressure, the densities and the size distributions of soil of various initial mixtures approach one another. The considerable difference in the density and crushability of the soil as a function of the size distribution of the initial mixture shows that prediction of the initial mixture on the basis of the jointing of the mass plays a major role in the prediction. (Doria-PTT)
W87-01382

CRITERIA OF SAFE OPERATIONAL DEFORMATIONS OF EARTH DAMS,
V. V. Malakhanov, M. A. Marchuk, and A. V. Serkov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 6, p 271-279, December 1985. 4 fig, 2 tab, 13 ref. Translated from Gidrotekhnische Stroitel'stro, No. 6, June 1985.

Descriptors: *Deformation, *Earth dams, *Hydraulic structures, *Dam stability, Dams, Hydraulic engineering, Engineering, Elevation, Mathematical studies.

A method is proposed for evaluating the operational state of earth dams based on measurements of deformations according to nominal criteria and maximum allowable criteria. An equation is presented to assign the periodicity of instrumental observations of deformations of earth structures as a function of the intensity of deformations and measurement error. In the period of time between instrumental observations, it is necessary to perform systematic visual inspections to detect signs of failure. The proposed method makes it possible to estimate the accuracy of the performed measurements and to reveal anomalies in the change in the character of deformations with time, which can be a consequence of the development of failure

processes or the result of a change in the operating conditions. (Doria-PTT)
W87-01388

OPTIMIZATION OF THE DESIGNS OF EARTH DAMS,
For primary bibliographic entry see Field 8A.
W87-01399

UNSTEADY GROUNDWATER DRAWDOWN IN EMBANKMENTS,
Ministry of Works and Development, Rotorua (New Zealand).
P. H. Mitchell, and B. Hunt.
Journal of Hydraulic Research, Vol. 23, No. 3, p 241-254, 1985. 10 fig, 1 tab, 8 ref, append.

Descriptors: *Groundwater, *Drawdown, *Embankments, *Groundwater movement, *Numerical analysis, *New Zealand, Hydraulics, Seepage, Flood control, Water level, Rivers, Mathematical studies.

Numerical solutions are developed for unsteady seepage through an embankment cross section that is typical of the many flood control embankments used in New Zealand. Free surface profiles following an instantaneous drop in river level are presented in dimensionless form and checked with a Hele-Shaw experiment. A criterion is found for assessing the applicability of the instantaneous drawdown assumption in any given application. The solutions are compared with commonly used solutions of the linearized and nonlinear Dupuit equation, and it is found that both Dupuit approximations break down because of relatively large vertical velocity components along the free surface that occur immediately after the sudden drop in river level. (Doria-PTT)
W87-01576

PERFORMANCE OF SOIL-CEMENT DAM FACINGS: 20-YEAR REPORT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
T. J. Casias, and A. K. Howard.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86-109360, A02 in paper copy, A01 in microfiche. Report REC-ERC-84-25, September 1984. 8 p, 4 fig, 4 ref.

Descriptors: *Soil cement, *Dam facings, *Materials testing, Slope protection, Riprap, Embankments, Erosion, Weathering, Wave action, Construction materials, Construction methods, Materials engineering, Performance evaluation.

The soil-cement slope protection on three Bureau of Reclamation embankment dams has been damaged enough to require repair. They were the first three Bureau embankments to use soil-cement in place of riprap, and have been in service 18-20 years. The soil-cement facings on later Bureau dams are still in excellent condition. The lack of bond between the soil-cement lifts, in combination with severe weather and wave action, appear to be the main factors contributing to the damage. Laboratory tests and field test sections indicate that cement applied between the soil-cement lifts may be a practical solution to prevent damage to the facing when severe weather and wave conditions exist. Another soil-cement test section is planned for a future Bureau dam. The test section will be incorporated into the soil-cement facing where both dry cement and a cement slurry will be used for the surface treatment between soil-cement lifts. (Author's abstract)
W87-01757

8E. Rock Mechanics and Geology

INVESTIGATION OF A COARSE ALLUVIAL FOUNDATION FOR AN EMBANKMENT DAM,
A. W. Hanna, G. Ambrosii, and A. D. McConnell.
Canadian Geotechnology Journal CGJOAH, Vol. 23, No. 2, p 203-215, May 1986. 15 fig, 1 tab, 12 ref.

Descriptors: *Alluvial deposits, *Dam foundations, *Earth dams, *Pichi Picun Lechu, *Dynamic cone penetration testing, *Wave velocity measurement, Dam construction, Dam stability, Water table, Field tests, Density, Rio Limay, Argentina.

Investigation of the coarse alluvial foundation for the Pichi Picun Leufu embankment (on Rio Limay, Argentina) is described and evaluated. Direct and indirect investigation methods are compared and an assessment is made of their relative adequacy in order to gain a realistic understanding of foundation conditions. Indirect methods — dynamic cone penetration testing and shear wave velocity measurement — calibrated by comparative testing in a test embankment, provided a satisfactory means of evaluating the density of thick alluvial deposits below the water table. Relationships of relative density, penetration resistance, and shear wave velocity are discussed. Dynamic penetration resistance normalized for effective overburden pressure appears to be the more sensitive indicator of changes in material density. (Author's abstract)
W87-01040

EFFECT OF THE DEGREE OF WEATHERING OF THE INITIAL ROCK ON THE STRENGTH PROPERTIES OF ROCK MATERIAL,
O. A. Pakhomov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 25-29, July 1985. 3 fig, 6 ref. Translated from Gidrotekhnische Stroitel'stro, No. 1, January 1985.

Descriptors: *Weathering, *Rock properties, *Structural engineering, *Dam construction, *Engineering geology, Engineering, Construction, Hydroelectric plants, Powerplants, Rocks.

The effect of weathering on the strength properties of rock in air-dry and saturated states was established using a large shear instrument. For coarse-fragmental soil of the investigated variety and negligible average degree of weathering, a change of the content N from 0 to 100% for the same degree of normal stress causes a decrease of the angle of shear by 5 degrees and accordingly worsens the other characteristics of the shear strength. The initial density of partially weathered rock material can be increased by its layerwise placement dry and mechanical compaction by vibrating rollers operating in an optimal vibration regime and linked with heavy static rollers. Useful embankments can be constructed from weathered soils by using artificial mixtures of strong and low-strength material obtained by excavator excavation of intermediate rock, where these materials are preliminarily placed as horizontal layers in a specified proportion by mass or volume. (Doria-PTT)
W87-01355

LABORATORY STUDIES OF GAS FLOW THROUGH A SINGLE NATURAL FRACTURE,
Golder Associates, Inc., Redmond, WA.
T. W. Schrauf, and D. D. Evans.
Water Resources Research WRERAO, Vol. 22, No. 7, p 1038-1050, July 1986. 14 fig, 2 tab, 19 ref.

Descriptors: *Gas flow, *Geologic fractures, Conductivity, Fluid pressure, Stress, Fracture deformation, Hydraulic properties, Model studies, Mathematical analysis, Flow rate.

The relationship between the aperture and gas conductivity of a single natural fracture was investigated in the laboratory. Fracture conductivity was evaluated as a function of both the applied fluid pressure gradient and average fracture aperture, the latter ranging from 600 to 200 micrometers. Fracture apertures were determined independently on the basis of both fracture deformation and fracture volume measurements. On the basis of these results, the following conclusions were drawn: (1) Initial contact aperture of a previously separated fracture surface is close to the mean asperity height. Changes in fracture aperture (fracture deformation) with normal stress were well described by strain energy relationships without regard to fracture geometry. Increased fracture compliance was directly related to shear deformation, which improves surface mating. This suggests that shear movement may be of greater importance to normal fracture deformation than previously believed; (2) The hydraulically determined fracture aperture, using a parallel plate model, was considerably less than the measured average fracture aperture. This suggests that empirical relationships between true average and equivalent parallel plate apertures based upon surface roughness alone may be sufficient to account for the combined effects of surface roughness, waviness, and contact area; (3) Flow rate through a fracture was inversely proportional to the fourth power of fracture aperture. A physical model based on an analogy to pipe flow was developed which reflects this fourth-power relationship and demonstrates the inadequacy of the parallel plate model. This model matched the experimental data well with regard to both linear and nonlinear fracture conductivities but is limited to fractures whose surfaces are in contact; and (4) The transition between linear and fully nonlinear flow was described well by a single equation containing both linear and nonlinear terms. This is consistent with similar observations for porous media. (Lantz-PTT)
W87-01443

INCREDIBLE TALE OF TEXASGULF WELL 7 AND FRACTURE PERMEABILITY, PARADOX BASIN, UTAH,
Wyoming Univ., Laramie. Dept. of Geology and Geophysics.
P. W. Huntoon.
Ground Water GRWAAP, Vol. 24, No. 5, p 643-653, September-October, 1986. 7 fig, 1 tab, 15 ref.

Descriptors: *Utah, *Wells, *Fracture permeability, *Geohydrology, *Paradox Basin, Geologic fractures, Limestone, Cane Creek, Salts, Sodium chloride, Hydrogen sulfide, Anisotropy, Transmissivity, Groundwater movement, Permeability.

Normal faults and associated extended joints form an extremely permeable zone in Pennsylvanian and Permian limestones and arkoses along the crest of the Cane Creek salt growth anticline of southeastern Utah. These same rocks in unfaulted states comprise an extensive regional confining layer sequence. Fluids in the fault zone are sodium chloride/hydrogen sulfide brines which have bleached all permeable flow paths within the units. Bleaching patterns in outcrops reveal that circulation in the fault zone is largely restricted to the fault planes and nearby extended joints. Orthogonal joints within the fault zone are also bleached but to a lesser extent. In contrast, bleaching of all joints a short distance from the faults is rare. The highly anisotropic permeability distribution observed is characterized by maximum principal permeability tensors oriented parallel to the strike of the faults and minimum principal tensor perpendicular to the fault planes. The productive zone has a transmissivity considerably in excess of 1,000,000 gallons/day-foot parallel to the strike of the faults. Fracture permeability is attributed to minute separations developed along faults and joints as the rocks containing them underwent extension perpendicular to the strike of the anticline. The causative extensional stress regime was imposed on the rocks as they were bent and stretched over the growing core of the anticline. The general conclusion is that extensional tectonic regimes are ideally suited for imprinting fracture permeability on brittle rock sequences. Such fractures include extensional joints and high angle normal faults. Small offsets appear to favor development of porosity because surface irregularities in the fracture planes are not ground off thereby forcing the facing surfaces to separate, and gouge development is minimized. (Author's abstract)
W87-01496

WATER AND AIR INTAKE OF SURFACE-EXPOSED ROCK FRACTURES IN SITU,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2A.
W87-01593

APPLICATIONS OF MICROGRAVITY SURVEYS TO SUBSURFACE EXPLORATION,
STS Consultants Ltd., Lansing, MI.
For primary bibliographic entry see Field 7B.
W87-01648

STRATIGRAPHIC DETERMINATIONS AND CORRELATIONS BASED ON BOREHOLE GEOPHYSICS,
Florida Geological Survey, Tallahassee.
For primary bibliographic entry see Field 7C.
W87-01661

THEORY & DESIGN CONSIDERATIONS OF A BOREHOLE ELECTROMAGNETIC CONDUCTIVITY PROBE,
Geonics Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 7B.
W87-01662

DEFINING GLACIAL STRATIGRAPHY WITH THE NEUTRON LOG,
STS Consultants Ltd., Green Bay, WI.
For primary bibliographic entry see Field 7B.
W87-01663

8F. Concrete

ROLLCRETE DAM DESIGN EVOLUTION,
W. G. Reinhardt.
Engineering News Record, Vol. 217, No. 2, p 32-33, July 10, 1986.

Descriptors: *Design criteria, *Dams, *Concrete dams, *Concrete, *Dam construction, Mass concrete, Oregon, Cofferdams, Reservoirs, Construction, Flood protection.

Elk Creek Dam, the world's first second-generation roller-compacted concrete (RCC) dam, is currently under construction north of Medford, Oregon. The 249-foot-high, 2,580-foot-wide multipurpose dam is the second-largest RCC dam under construction in the U.S., and will contain about 1 million cu yd of RCC. For the heart of the dam, the RCC has much more cement, fly ash, and water than does the mix used at the dam's predecessor at Willow Creek. Layers of fresh RCC are spread by bulldozers helping to compact the material and eliminate air bubbles that create voids at the lift interfaces. Ten vertical contraction joints will be installed across the dam to relieve heat stress. To meet the June 30, 1988 completion deadline, the contractor must place RCC at the rate of 600 cu yd per hour almost continuously for six months. (Doria-PTT)
W87-01159

THERMAL CRACKING IN CONCRETE OF THE SAYANO-SHUSHENSKOE DAM,
L. I. Markin.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 1-5, July 1985. 5 tab, 3 ref. Translated from Gidrotekhnische Stroitel'stro, No. 2, January 1985.

Descriptors: *Cracks, *Dams, *Concrete dams, *Mechanical failure, *Thermal stress, Sayano-Shushenskoe Dam, Arch dams, Gravity dams, Stress, Dam construction, Construction, USSR.

The Sayano-Shushenskoe dam (Siberia) was constructed of concrete with high thermal properties in blocks whose sizes considerably exceed the analogous parameters for hydraulic structures constructed in that region. Solidity of the enlarged blocks was provided by traditional technological and technical measures not requiring considerable additional expenditures. A large majority of the cracks in the dam were caused by the use of cantilever formwork, which called for early striking of the concrete. However, the use of the industrial cantilever formwork is justified, since the cracks have a negligible width and depth of penetration into the masses, and do not pose a danger for the structure. Through-cracking in the first column of the dam, related to the presence of inspection galleries in the middle of its width, can be eliminated by locating the latter at a distance from the column joint of not more than 0.2-0.25 of the column width. Seepage through the through-cracks on the upstream side was negligible, and at present is practically absent. (Doria-PTT)
W87-01350

STRESS-STRAIN STATE OF UNSEALED GRAVITY DAMS,
E. N. Elizarov, M. S. Lamkin, N. N. Smyslova, and V. I. Khelevin.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 3, p 130-135, September 1985. 4 fig, 1 tab, 6 ref. Translated from Gidrotekhnische Stroitel'stro, No. 3, March 1985.

Descriptors: *Stress, *Strain, *Gravity dams, *Dam design, *Stress analysis, Hydraulic structures, Dam stability, Dams, Tensile stress, Thermal stress, Hydraulic engineering.

The 'unsealed' type of concrete gravity dam with sectionalizing of the concrete layers into overlapped blocks has recently attracted attention. The economic advantages of unsealed dams increases with the introduction of methods of forming the temperature deformation joints without formwork, e.g., by the method of organized cracking. This method of construction is especially effective for high dams with a large volume of concrete masonry. A comparative analysis is presented of the stress state of sealed and unsealed dams. It is found that with the fulfillment of the standard requirements imposed on the stress state, the unsealed dams with batter-arranged stepped joints have under operating loads a reliability no less than that of sealed dams with vertical columnar masses being constructed under analogous conditions. However, the reliability of unsealed dams should be investigated further in regions of high seismicity. (Doria-PTT)
W87-01367

TECHNOLOGY OF MANUFACTURING PRECAST REINFORCED-CONCRETE ELEMENTS OF THE PENSTOCKS OF PUMPED-STORAGE STATIONS,
I. S. Moiseev, I. I. Vaisblat, M. M. Klimova, A. N. Anchukov, and M. N. Fedorov.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 191-195, October 1985. 3 fig. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Precast concrete, *Reinforced concrete, *Concrete construction, *Penstocks, *Pumped storage, *Concrete technology, Storage, Concretes, Pipes, Technology.

The problem of manufacturing precast reinforced-concrete elements of penstocks with an inside diameter of 7.5 m for a design pressure of 1.7 MPa was solved in the USSR using the unit-line method. The technology of the unit-line manufacturing method is discussed; more than 200 precast elements have been manufactured, and the assembly of the first penstock is completed. The line has been found to be efficient, providing high-quality elements. However, some components of the equipment, in particular the platform vibrator and formwork, need improvement. These works are being carried out, and improvement of the technological line is continuing. The output of the yard has reached 26 elements per month. After improvements, it will manufacture two 720-m-long penstocks (368 elements) annually. (Doria-PTT)
W87-01377

ESTIMATION OF THE RELIABILITY OF CONCRETE GRAVITY DAMS UNDER SEISMIC LOADS WITHIN THE FRAMEWORK OF THE STANDARD METHOD,
S. G. Shul'man.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 4, p 217-222, October 1985. 1 tab, 10 ref. Translated from Gidrotekhnische Stroitel'stro, No. 4, April 1985.

Descriptors: *Seismic loads, *Estimating, *Concrete dams, *Gravity dams, *Estimating equations, *Dam stability, Mathematical studies, Stress, Strain, Hydraulic design, Statistical methods, Hydraulic structures.

An approach is developed for estimating the reliability of concrete gravity dams. An analysis of the probabilistic characteristics of the random variables figuring in the equation for seismic inertial loads and corresponding numerical experiments indicate that substantial simplifications are possible at a number of stages of the solution, making the method rather simple. The method permits assessing the role of various factors and comparing variants of the structures, and in the future it will permit estimating the reliability with consideration of the probabilistic characteristics of all main parameters of the problem. Examples are provided to show the effect of certain factors on the reliability of dams under an unusual combination of loads. (Doria-PTT)
W87-01381

PREDICTION OF THE GRADE STRENGTH OF HYDROTECHNICAL CONCRETE,
B. A. Kalinkin.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 5, p 253-254, November 1985. 1 fig, 1 tab, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 5, May 1985.

Descriptors: *Strength, *Concrete testing, *Concrete strength, *Concretes, *Concrete technology, Portland cements, Cements, Prediction.

Determination of the grade strength of hydrotechnical concrete requires three months; therefore, it is urgent to obtain its predictive estimates. The simplest estimate (using average hardening rate coefficient) is not appropriate to modern practice, while the use of empirical formulas is laborious and of uncertain accuracy. An empirical formula is proposed that does not contain such coefficients, and predicts the grade strength of hydrotechnical concrete more accurately than existing formulas. This formula has been verified for various grades of Portland cement concretes in practically the entire range of water:cement ratios used. (Doria-PTT)
W87-01385

USE OF COMBINED SURFACTANT ADDITIVES IN CONCRETE OF HYDRAULIC STRUCTURES,
V. B. Sudakov, T. G. Ginzburg, A. A. Bel', N. V. Miklashevich, and G. V. Morozova.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 6, p 316-320, December 1985. 2 fig, 1 tab, 11 ref. Translated from Gidrotekhnische Stroitel'stro, No. 6, June 1986.

Descriptors: *Surfactants, *Concrete additives, *Concretes, *Hydraulic structures, *Concrete technology, Concrete mixes, Portland cements, Cements, Construction.

The use of surfactant additives is one of the most effective methods of regulating the structure and properties of concretes. Compositions of two or more additives properly selected can reduce the negative effect of individual additives while intensifying their positive aspects. Combined additives consisting of a plasticizer and air-entraining component, specifically the formulation SYL + NAR, have found use in hydrotechnical construction in recent years. Long-term investigations indicate that the composition SYL + WCA (wood-chemical additive) has a more favorable effect on concrete strength. Cement consumption was found to decrease 0.9% for each percent of strength loss of concrete with the addition of SYL + NAR; 1% of air entrained by this additive causes a 4.6% strength loss. For concrete with the additive SYL + WCA, these indices are 2.4% and 1.8%, respectively. (Doria-PTT)
W87-01392

DURABILITY OF CONCRETE AND CORROSION THEORY,
V. M. Moskvin.

Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 379-385, February 1986. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Durability, *Concretes, *Corrosion, *Concrete technology, Cements, Waterproofing, Portland cement, Concrete mixes, Materials engineering, Structural engineering.

Problems of concrete corrosion are examined as a factor affecting the durability of ordinary concrete whose binder is Portland cement and components are fine aggregate, natural or artificial sand, and coarse aggregate, also natural or artificial, of a dense or porous structure. Concrete aggregates together with cement create a concrete structure determining its permeability for an external corrosive medium and conditions of its movement in concrete during seepage, capillary transport, and heat and mass transfer. Concrete corrosion processes are classified into three groups. The main characteristics of the corrosion process are described for each group, and treatment measures for corrosion protection are discussed. (Doria-PTT)
W87-01402

SERVICEABILITY OF AN EARTH DAM WITH A REINFORCED-CONCRETE FACING,
For primary bibliographic entry see Field 8A.
W87-01405

CONDITIONS OF THE COMBINED STATIC WORK OF A PRECAST CONCRETE-ENCASED STEEL CONDUIT AND PILE GRILLAGE,
For primary bibliographic entry see Field 8A.
W87-01408

ROLLER COMPACTED CONCRETE DEVELOPMENTS IN THE USA,
Portland Cement Association, Denver, CO.
K. D. Hansen.
Water Power and Dam Construction, Vol. 38, No. 1, p 9-12, January 1986. 3 fig, 2 tab, 10 ref.

Descriptors: *Compacted concrete, *Dam construction, *Economics, *Overflow structures, Dams, Engineering, Design, Seepage control.

Roller compacted concrete is regarded as a powerful new tool by dam builders in the USA, and is gaining wide acceptance. The main reason for an r.c.c. gravity structure is economic. Difference of opinion still exists on design aspects of r.c.c. dams, for example the concrete mix design, and seepage control measures. However, dam designers agree that the upstream face should be verticle and the spillway should be incorporated into the structure. While the large r.c.c. dams will continue to receive the greatest publicity, the use of smaller volumes of r.c.c. for the rehabilitation of existing earth embankments will produce the greatest number of future projects. (Main-PTT)
W87-01416

ROLLCRETE: SOME APPLICATIONS TO DAMS IN SOUTH AFRICA,
Department of Water Affairs, Forestry and Environmental Conservation, Pretoria (South Africa).
F. Hollingworth, and F. H. W. M. Druyts.
Water Power and Dam Construction, Vol. 38, No. 1, p 13-16, January 1986. 6 fig, 1 ref.

Descriptors: *Rollcrete, *Dam construction, Roller compacted concrete, *South Africa, Concrete mix, Engineering, Dam faces, Dams, Dam gallery.

Following the incorporation of an experimental rollcrete (roller compacted concrete) section in a conventional concrete gravity dam in South Africa, two rollcrete dams are now in the initial stages of construction in the country - De Mist Krall weir on the Little Fish river and Zaaihoek dam on the Slang river. These are described in this article. In particular, the authors discuss the rollcrete mix, the method of placing, the means of forming the exterior faces and of creating voids such as galleries within the body of the dam. Rollcreting for dams is still in its infancy, but already there are as many approaches to the concept as there are proponents. Our approach at this stage is conservative, with mixes of a cementitious materials content in the order of 115 kg per cubic m with a relatively high pozzolan content, and compacted layer thicknesses of 250 mm. (Main-PTT)
W87-01417

DESIGN CONSIDERATIONS FOR ROLLER-COMPACTED CONCRETE DAMS,
Malcolm Pirnie, Inc., White Plains, NY.
M. R. H. Dunstan.
Water Power and Dam Construction, Vol. 38, No. 1, p 21-25, January 1986. 5 fig, 2 tab, 19 ref.

Descriptors: *Design, *Rollercompacted concrete dams, *Dam construction, *Economics, Gravity dams, Construction, Engineering, Dam faces, Paste content, Precast concrete.

Although roller compaction of concrete is a relatively new method of construction for dams, the few dams that have been completed to date have shown that the method promises considerable economies when compared with conventional concrete dam building, and even when compared with fill dams. This article discusses the different approaches that have been used, and shows how the performance of roller-compacted concrete can be predicted. The method of design for roller compaction for dams is sufficiently advanced to enable the concrete to be designed for gravity dams of any reasonable height. (Main-PTT)
W87-01418

CONSTRUCTION OF THE MIDDLE FORK AND GALESVILLE R.C.C. DAMS,
Morrison-Knudsen Engineers, Inc., San Francisco, CA.
H. Jackson.
Water Power and Dam Construction, Vol. 38, No. 1, p 25-27, January 1986. 2 fig.

Descriptors: *Dams, *Roller-compacted concrete, *Dam construction, Colorado, Oregon, Design, Construction, Gravity dams.

Since completion in 1982 of Willow Creek dam, the first gravity dam constructed in the United States entirely using roller-compacted concrete, there has been a surge of interest and activity in the construction of dams by this new and promising technique. The design and construction of two of these projects, Galesville dam in Colorado and Middle Fork dam in Oregon, are described. (Author's abstract)
W87-01419

DEVELOPMENT OF THE R.C.D. METHOD IN JAPAN,
Ministry of Construction, Tokyo (Japan).
S. Shimizu, T. Yanagida, and S. Jojima.
Water Power and Dam Construction, Vol. 38, No. 1, p 28-32, January 1986. 7 fig, 1 tab, 4 ref.

Descriptors: *Dam construction, *Rolled compacted dams, *Construction joints, Japan, Engineering properties, Elevation, Vertical construction joints, Rich mix concrete, Vibrating rollers, Dam faces.

Since 1974 the method of construction by roller compacted dam (r.c.d.) concrete has been studied intensively in Japan, and two dams have already been built by the method. The Shimajiawa and the Ohkawa dams demonstrated the success of the method, and provided valuable experience which is now being used to refine the technique. The r.c.d. method has the following characteristics: concrete of stiff consistency; surface of the poured concrete has the same elevation; mixed concrete conveyed by a fixed crane to the surface of the concrete placement and off-loaded by dump trucks to the surface to be concreted; concrete spread in three to four layers for each lift by bulldozers; one lift is 50 to 100 cm thick and rolled and finished by vibrating rollers cut by a vibrating joint cutter; at the construction joint, the surface is treated for joining; and a rich mix concrete is used for a stretch of 3 m at upstream and downstream sides and is compacted by internal vibrators. The concrete mix proportions, engineering properties, execution at the construction joints, and the upstream and downstream faces of a rolled compacted dam are discussed. (Main-PTT)
W87-01420

ALKALIZATION OF A HIGH-ELEVATION SIERRA NEVADA STREAM,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 4C.
W87-01447

PERFORMANCE OF SOIL-CEMENT DAM FACINGS: 20-YEAR REPORT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8D.
W87-01757

8G. Materials

ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS OF A ROTATING CYLINDER CONTAINING AN INTERNAL AXIAL CRACK,
UKAEA Risley Nuclear Power Development Labs. (England).
J. K. Sharples.
Available from Her Majesty's Stationery Office, 49 High Holborn, London WC1V 6HB, July 1985. 43 p, 16 fig, 4 tab, 12 ref, 2 append.

Descriptors: *Strength of materials, *Nuclear power plants, *Elastic properties, *Finite element method, *Rotating cylinders, Tensile strength, Cracks, Plasticity, Plastics, Steel, Computer programs, Stress-strain curves.

A large rotating cylinder rig has been proposed by the United Kingdom Atomic Energy Authority (UKAEA) to investigate the fracture of heavy section steel under mechanical and thermal loads, and a small scale prototype has been built to demonstrate its feasibility. Elastic-plastic finite element analyses have been carried out on the prototype rotating cylinder (containing a full length axial crack along the bore) in order to establish the extent of yielding in the cylinder with increasing rotational speed. Both the BERSAFE and ABAQUS finite element computer codes have been utilized for the assessment, and in the case of the former, values of J and the modified integral J* have been evaluated. The stress-strain relationship was idealized as elastic-perfectly plastic. The main conclusions were, that for an internal axial crack extending halfway through the wall of the cylinder, the cracked ligament will yield at a rotational speed of between 5893 and 6690 rpm, and that the cylinder will become fully plastic at approximately 8000 rpm. These values compare favorably with those evaluated from calculation methods previously proposed. The validity of the earlier calculational methods was also demonstrated for crack lengths considered in the investigation. By assuming a fracture toughness (K sub IC) value of 200 MPA square root of m for the material, the results from the J and J* integral solutions indicate that crack growth may results from average cracks at rotational speeds exceeding 6000 rpm. (Lantz-PTT)
W87-00888

ALUMINUM-THIOUREA INHIBITORS OF MILD STEEL CORROSION IN HIGH SPECIFIC SALINITY WATER. COMPATIBILITY WITH CALCIUM, MAGNESIUM AND FERROUS IONS AT VARIOUS TEMPERATURES,
Higher Inst. of Mechanical and Electrical Engineering, Sofia (Bulgaria).
For primary bibliographic entry see Field 3C.
W87-01104

WATERTIGHT ELEMENTS OF EARTH HYDRAULIC STRUCTURES,
V. D. Glebov.
Hydrotechnical Construction HYCOAR, Vol. 19,

No. 2, p 62-67, August 1985. 4 fig, 1 tab, 7 ref. Translated from Gidroteckhnische Stroitel'stro, No. 2, February 1985.

Descriptors: *Earthworks, *Hydraulic structures, *Earth dams, Dam design, Asphaltic concrete, Construction, Dam construction, Polymers, Films, Materials engineering, Engineering.

Nonsoil types of watertight materials for earth dams, including asphalt concrete membranes, polymer films, metal facings and membranes, grout cores, and sprayed facings (liquid, cast, aerosol, etc.) are examined. Film facings are the most economic type of watertight element currently available. As the head increases and the area of facing decreases, the difference in cost of film becomes less noticeable. (Doria-PTT)
W87-01359

METHODS OF GEODETIC MEASUREMENTS OF THE FOUNDATIONS OF HIGH DAMS,
A. A. Karlson.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 6, p 264-271, December 1985. 7 fig, 12 ref. Translated from Gidrotekhnische Stroitel'stro, No. 6, June 1985.

Descriptors: *Dams, *Hydrodynamics, *Geophysics, *Hydraulic engineering, *Dam foundations, Engineering, Reservoirs, Banks, Deformation, Hydraulic structures, USSR.

High-precision geodetic measurement performed at the Inguri hydrostation (USSR) recorded a rise of 10 mm of the foundation of the arch dam and shore surface in the lower pool during the partial filling of the reservoir. This same phenomenon has been noted at other hydropower installations. However, earlier observations and theoretical calculations have indicated that filling of a reservoir is associated with settlement of the banks and foundations. The author presents numerical characteristics at those hydrostations where a rise has been recorded, along with information about the dynamics of the process and estimation of the accuracy and reliability of the results obtained. (Doria-PTT)
W87-01387

CORROSION OF EMBEDDED PARTS OF INTAKE WORKS OF THE MINGECHAUR HYDROELECTRIC STATION,
M. S. Trifel', and Y. Z. Shikhaliev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 6, p 308-315, December 1985. 6 fig, 6 tab, 6 ref. Translated from Gidrotekhnische Stroitel'stro, No. 6, June 1985.

Descriptors: *Corrosion, *Hydraulic equipment, *Hydroelectric plants, *Intakes, *Cathodic protection, Powerplants, Hydraulic structures, Gates, Trash racks, Turbines, Electrochemistry, Cathodes, Electrodes, USSR.

An investigation of the kinetics of corrosion reactions on specimens and actual structures of hydroelectric intake works indicates the possibility of the formation of aeration and concentration cells, the electrodes of which contact environments with different pH values. The observed corrosion rates dictate the need to protect embedded parts in the underwater zone from corrosion. The cheapest, simplest, and most technologically feasible method of protecting embedded parts of hydrostations is by electrochemical protection, specifically cathodic polarization. (Doria-PTT)
W87-01391

DESIGN AND EVALUATION OF IN-PLACE CONTAINMENT STRUCTURES UTILIZING GROUND WATER CUTOFF WALLS,
For primary bibliographic entry see Field 5G.
W87-01670

DESIGN OF SOIL-BENTONITE BACKFILL MIX FOR THE FIRST ENVIRONMENTAL PROTECTION AGENCY SUPERFUND CUTOFF WALL,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
For primary bibliographic entry see Field 5G.
W87-01671

EFFECTS OF WELL-CASING COMPOSITION AND SAMPLING METHOD ON APPARENT QUALITY OF GROUND WATER,
R. L. Houghton, and M. E. Berger.
IN: The Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 23-25, 1984. The Fawcett Center, Columbus, Ohio. p 203-213, 6 fig, 3 tab, 18 ref.

Descriptors: *Well casings, *Materials testing, *Sample preparation, *Groundwater quality, *Water sampling, Polyvinyl chloride, Acrylonitrile-butadiene-styrene, Pumps, Wells, Aquifers.

The apparent quality of groundwater may be misleading due to a variety of factors associated with sampling methods. To determine the effects of the composition of the well casing on the quality of sampled water, adjacent wells installed to the same depth and cased either with PVC, ABS or steel were sampled. PVC and ABS casings caused increased organic-carbon concentrations. The ABS casings is more adsorptive and affected by leaching than is the PVC casing. Steel casing affected metal concentrations. To determine the effects of commonly used groundwater sampling methods on the composition of sampled water, 18 wells completed in aquifers of various depths and containing various water types were sampled with various pumps and samplers. Gas-reciprocating pumps failed to maintain pressure within discharge hoses and permit minor sample degassing, resulting in precipitation of carbonate minerals. Peristaltic and submersible-centrifugal pumps create partial vacuums in pump lines, causing the degassing of volatile constituents from samples. Loss of carbon dioxide causes a shift in carbonate equilibria, an increase in sample pH and precipitation of carbonate minerals. Air-lift pumps also cause extensive sample degassing by gas streaming, with the same results as peristaltic and centrifugal pumps. Air-lift pumps also oxygenate sample water causing a significant depletion of many trace metals by promoting formation of poorly soluble metal oxides. Kemmerer-type thief samples produced no statistically significant alterations. Conventional thief samplers slightly oxygenate sample waters during insertion into wells. (See also W87-01669) (Lantz-PTT)
W87-01692

CORROSION PREVENTION AND CONTROL IN WATER TREATMENT AND SUPPLY SYSTEMS,
Environmental Science and Engineering, Inc., Gainesville, FL.
J. E. Singley, B. A. Beaudet, P. H. Markey, D. W. DeBerry, and J. R. Kidwell.
Noyes Publications, Park Ridge, New Jersey, 1985. Pollution Technology Review No. 122. 313 p.

Descriptors: *Corrosion control, *Water treatment, *Water conveyance, Water quality control, Cost analysis, Lead, Cadmium, Drinking water, Zinc, Iron, Copper.

Corrosion prevention and control methodology for water treatment and supply systems is detailed in this book. The information supplied will provide water treatment managers and operators with an understanding of the causes and control of corrosion. The corrosion of water treatment and supply systems is a very significant concern. Not only does it affect the aesthetic quality of the water but it also has an economic impact and poses adverse health implications. Corrosion by-products containing materials such as lead and cadmium have been associated with serious risks to the health of consumers of drinking water. In addition, corrosion-related contaminants commonly include compounds such as zinc, iron, and copper, which adversely affect the aesthetic aspects of the water. The book is presented in two parts. Part I is basically a guidance manual for corrosion control with sections on how and why corrosion occurs and how best to handle it. Part II reviews the various materials used in the water works industry and their corrosion characteristics, as well as monitoring and detection techniques. Emphasis is placed on assessing the conditions and water quality characteristics due to the corrosion or deterioration of each of these materials. (Lantz-PTT)
W87-01769

8H. Rapid Excavation

CALCULATION OF SAFE PARAMETERS OF AIR SHOCK WAVES FOR UNDERWATER EXPLOSIONS,
N. I. Smolii, and M. I. Ganopol'skii.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 1, p 22-24, July 1985. 2 fig, 6 ref. Translated from Gidrotekhnische Stroitel'stro, No. 1, January 1985.

Descriptors: *Underwater, *Explosions, *Construction, *Hydraulic structures, Environmental effects, Prediction.

A functional relationship is presented for calculating the pressure at an air shock-wave front in underwater explosions of plaster-blasting charges. The maximum permissible mass of the charge and safe distance for objects can be calculated for an assigned value of the critical pressure at the air shock-wave front. (Doria-PTT)
W87-01354

INVESTIGATION OF STRAY CURRENTS AND INCREASE OF THE SAFETY OF ELECTRIC BLASTING OPERATIONS,
Y. S. Petrov, Y. P. Maskov, A. A. Silaev, V. I. Vasil'chenko, and V. V. Minaev.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 438-442, February 1986. 4 fig. Translated from Gidrotekhnische Stroitel'stro, No. 8, August 1985.

Descriptors: *Safety, *Blasting safety, *Electric currents, *Rapid excavation, *Construction, Hydroelectric plants, Powerplants, Electrical equipment, Electrical studies.

Recommendations are developed to increase the safety of electric blasting operations with respect to sources of stray currents and the shot-firing circuits (SFC) when constructing underground hydroelectric stations. These include: prevention and maximum possible reduction of the duration of emergency operating regimes of electric power plants; maintenance of the insulation of all elements of the electric supply system; elimination of the extension of a dangerous potential into the blasting zone through extended metal devices; monitoring of stray currents; use of low sensitivity electric detonators and selection of the safest arrangement and optimal configuration of the SFC; maintenance of the normal insulation resistance of the SFC; and checking of the insulation resistance of the SFC. In addition, the area covered by the wires of the SFC should be minimal, and the trunk lines should be twisted together or special cables should be used. (Doria-PTT)
W87-01409

CALCULATION OF THE PARAMETERS OF DRILLING AND BLASTING OPERATIONS TO OBTAIN PERMISSIBLE OVERBREAKS AND UNDERBREAKS AT FOUNDATIONS,
A. E. Azarkovich, and M. I. Shuifer.
Hydrotechnical Construction HYCOAR, Vol. 19, No. 8, p 443-450, February 1986. 4 fig, 2 tab, 7 ref. Translated from Gidrotekhnische Stroitel'stro, No. 9, August 1985.

Descriptors: *Drilling, *Blasting, *Rapid excavation, *Construction, *Foundation rocks, Statistical analysis, Hydroelectric plants, Powerplants, Engineering geology, Foundation failure.

The mechanism of formation of overbreaks and underbreaks resulting from blasting preparation of rock foundations of structures is analyzed, and a calculation scheme for determining the maximum values of overbreaks and underbreaks is proposed.

Data are given on the actual values of overbreaks and underbreaks at rock foundations of a number of large hydroelectric stations; a statistical analysis is performed, and the closeness of the calculated and actual maximum values of overbreaks and underbreaks and also of the range of variations of the unevenness of foundations is shown. A method is proposed for calculating the parameters of drilling and blasting operations at the lower contour of pits of important structures to obtain the given value of overbreaks and underbreaks of rock at the foundation of structures. (Doria-PTT)
W87-01410

8I. Fisheries Engineering

SPATIAL DISTRIBUTION OF ENTRAINED FISH LARVAE IN A POWER PLANT DISCHARGE CANAL,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
D. J. Jude, P. J. Mansfield, S. F. DeBoe, and F. J. Tesar.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 5, p 1070-1074, May 1986. 4 tab, 11 ref.

Descriptors: *Environmental effects, *Data acquisition, *Powerplants, *Fish, *Sampling, Larvae, Lake Erie, Gizzard shad, Freshwater drum, Spatial distribution.

Larval fish were sampled with plankton nets during June and July at 1-, 3-, and 5-m depths at three stations in the 6-m-deep discharge canal of the Monroe electricity-generating plant on western Lake Erie. Of nine species, gizzard shad (Dorosoma cepedianum) accounted for 96% of all larval fish collected in June and, along with freshwater drum (Aplodinotus grunniens), 78% of those taken in July. Densities of fish larvae at the three depths, and at two of the three stations sampled, were not significantly different. Mean densities of gizzard shad and total fish larvae in June were significantly higher at one station. Fluctuating and significantly lower velocity at that station, causing the flowmeter not to turn while the net was still filtering water, was suspected of causing inflated densities. Generally sizes of larvae were not stratified by depth or station; differences that were found were small. Thus, it was concluded that to obtain samples with representative species, densities, and sizes of entrained fish larvae, a stationary net should be positioned where the water has uniform high velocity and is well mixed. (Author's abstract)
W87-01274

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

ACID DEPOSITION: LONG-TERM TRENDS.
National Research Council, Washington, DC. Committee on Monitoring and Assessment of Trends in Acid Deposition.
For primary bibliographic entry see Field 5C.
W87-00971

10F. Preparation Of Reviews

GROUNDWATER FLOW IN LOW-PERMEABILITY ENVIRONMENTS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-01620

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